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Committee Work in the N. E. L. A.

If one runs over the annual reports of the National Electric Light Association it at once becomes evident that a great deal of important work has been done by the committees of the association and that their reports form a very valuable contribution to the art of electric lighting in all its ramifications. On the other hand, it is unfortunately the fact that these reports very seldom serve as the basis of any concerted action. They are listened to with interest and approbation, and then in the press of convention business are pigeon-holed. Some few members take the information to heart and may personally act upon it, yet the association as a whole devotes far too little time to discussing and following up the work which it has itself outlined as important. The National Electric Light Association is, so far as its scope extends, perhaps the most influential electrical body in the country, for it is composed of those who are directly guiding the electric lighting industry in a multitude of places. An academic body may solemnly get together and resolve even until the coming of the millennium without producing any perceptible effect. Its lucubrations are amiably read by the recipients and are then filed in the waste basket. But the N. E. L. A. has the power to act, and therein lies its strength.

We believe that it has a splendid capacity which should be more fully utilized for unifying practice and for handling large questions in a broad and effective way. It is one of the very few organizations capable of taking an effective stand and getting results. It is able, too, to cooperate effectively with other bodies and to bring a tremendous amount of influence to bear where it will do good. It ought to act as a body far more frequently than it actually does and take a firm stand on matters that are worth it. We note, for example, that in the executive session some very important subjects come up for discussion. If the association would systematically devote more attention to this executive session work, and after due deliberation, would act substantially as a unit on the issues involved, it could greatly strengthen the whole industry. Of course, one cannot effect unanimity on mooted questions, nor that every company represented in the association should be able to take concurrent action, yet it should result to throw great weight into the united action. Many questions involving public policies are constantly arising in the electric lighting business and are reflected from one company to another, sometimes in a very disconcerting manner. If the association could exercise its good offices in such instances is might be possible to secure concerted action in the particular territory affected in such way as to clear up many outstanding difficulties. Even the matter of rates, in which there are many theories and as many kinds of practice, could be to a certain extent brought into line in this way. When a committee charged with im-

portant matters reports, its work should be sharply followed up, and if the subject permits, the report should be made the basis of such concerted action as would help the association as a whole.

The Electric Light Convention.

The convention to be held next week in Washington by the National Electric Light Association is the thirtieth since the body was organized in 1885, and it is thirteen years since the National Capital was last visited, for the seventeenth meeting. A good deal of history has been made in the central station industry in the twenty-two years, and the growth of electric light and power since 1894 has certainly been very remarkable. It would appear that the United States, Mexico and the West Indies had at the end of 1906 no fewer than 4900 central stations, or for the North American continent including Canada, more than 5000. The investment in the United States is estimated to have reached $850,000,000 and the gross income is put at about $165,000,000. This is obviously a public utility field of no mean proportions, and its importance becomes even more noteworthy when we consider its close physical and financial affiliations with traction, water and gas supply.

Such is the industry that the association has aimed to represent, and it may be fairly said that to-day the association is more nearly and more truly representative than ever before. It may not yet include 1000 companies, but it soon will, and those that are in its membership have undeniably the bulk of the investment in the industry, and are operated by the leaders in the art. Not a single great company is outside the ranks, and it will readily be admitted that the capital, output, earnings and employees of such systems as those of New York, Brooklyn, Boston, Chicago, Cleveland, Cincinnati, Denver, Washington and Detroit, to mention no others, are in a sense controlling. The census of 1902 showed that in six cities was concentrated 20 per cent of the plants and that they yielded 25 per cent of the income, of all the stations of the country. But after all there is weight and power in numbers, and this great association is wisely doing its best to enlist the minor companies in membership. In this manner the attendance at the conventions is swelled, a large variety of topics is available for discussion from more widely different standpoints, and on public questions a fuller influence is exerted.

The Association has sustained many vicissitudes in its career, and has not always lived up to the whole measure of its opportunity, but it has always been useful, and can look back with pride on a successful career of nearly 25 years. It now faces a future beset with problems in the art that it can do much to settle and solve, and it has the control of forces that make it a mighty engine for the service of the industry. Its greatest good fortune has always been its power to rally to its support men of vigor and character, each setting his own seal on some new phase or development in its history.

Contracts for Street Lighting.

We note that the topic of contracts for street lighting has an important place in the convention. It is one of the most intricate and troublesome ones with which the association has to do, and most vitally affects its business. It is high time that some concerted action were taken about it. Especially at the present moment the art is changing rapidly, new illuminants of greatly increased efficiency are coming into use, and unless care is taken some very troublesome precedents are likely to be set. It is a time of rapid change when one must be extremely cautious, and precipitate action is peculiarly dangerous. It may be possible to draw up a general scheme for lighting contracts at the present moment, but would it be worth much in a twelvemonth? Even the question of specifying illumination vs. candle-power or watts is one that needs to be very cautiously handled. The recent litigation at Colorado Springs shows the difficulties of the case even when in the relatively simple form of a comparison between two very well known sources of light. There is just now a tendency toward shifting the basis from watts or light to illumination, the wisdom of which seems somewhat dubious. There is no question that in the last resort illumination is the thing desired, but it by no means follows that it is the thing to be measured for the purposes of sale.

Practice abroad in such matters is undergoing a marked series of changes, and it would be very desirable if action here could be made harmonious with the precedents elsewhere. In all matters of standards of illumination some definite international action is extremely necessary, and we hope that the N. E. L. A. will go slowly and look toward such an end. There is at present no international body with any wide authority. The only one with really international standing labors under the disadvantage of being purely electrical, which is a serious handicap in securing formal international action on things which necessarily involve other interests. The Illuminating Engineering Society with its more general membership has done a wise thing in appointing a committee to deal with standards, which is now getting in touch with the more highly special bodies here and abroad interested with a view of getting some sort of united action. It would be well for the N. E. L. A. to consider the advisability of helping on this cause, whatever it may seem wise to do in the matter of contracts. Standards of light and of illumination we must have, whatever illuminant we may chance to deal with. Until such standards are legalized the whole matter will be in a most unsatisfactory state. The N. E. L. A. can do a great deal if it will to bring about this result, and we earnestly hope that it will put its shoulder to the wheel. As regards anything like a standard specification for street lighting, it had better move steadily but very cautiously, lest it find out too late that it has singed its paw in pulling somebody's commercial chestnuts out of the fire. It is no joke to devise a contract suitable for putting even electric arcs on an even basis without opening a gate for attack.

Modern Rate Systems.

The prosperity of the central-station company is so much dependent on a proper system of rates, and so many of the smaller companies are at the present time considering readjustment of rates in order to be able to get and retain profitable classes of business, that we present elsewhere in this issue a rather comprehensive review of the theories upon which modern systems of charging for energy for lamps and motors have been based, together with specific examples of typical rate

systems. In making a general classification of the systems commonly in use in the United States, it is surprising even to one familiar with the situation to note how few general headings it requires to include nearly all of these rate systems; but, of course, there is infinite variation in the way these systems are applied in different cities. The article deals only with those rate systems which make a somewhat serious attempt to charge the customer about what his service costs the company, plus a reasonable profit. For this reason practically no consideration is given in the article to the well-known old-fashioned flat-rate method of charging or to the straight meter rate in which the cost per kw-hour is the same to all kinds of customers, usually modified by discounts based on quantity only. The latter is admitted by all to be unjust to the best customers the company has, namely, those using power many hours per day. For these the rate is too high, while, on the other hand, it may not be high enough to cover anywhere near the cost of serving the customers requiring service only a short time each day.

Those who defend the straight meter rate do so not on the grounds of justice or equity, but because it is simple and tends to favor a lot of small customers who have considerable talking and voting power in the community. This carries the implication that the modern system of rates, which aims to charge for each class of service what it is worth, will be unfavorable to all small customers. On the contrary, it is more favorable to the small customer entitled to low rates than is the straight meter rate. Summed up briefly, the aim of all modern rate systems is to make each customer pay somewhere near the fixed charges on the investment made necessary by his installation and to give a low rate per kw-hour after once these fixed charges are taken care of. The question of investment in apparatus and lines to be ready to serve a customer is such an important part of the central-station service cost that no other principle can safely be followed. While the article contains nothing new to the veteran of many electric light conventions who has followed the question of rate-making closely, we believe it will be of interest to many of the smaller central-station companies because it places in convenient and compact form considerable information as to rate-making which has heretofore been scattered and inaccessible to many.

A TYPICAL NEW-BUSINESS ORGANIZATION.

Considerable space has been given in our columns in months past to the organization of the business-getting department of the central station company at Denver, as well as to the departments of other companies patterned after the pioneer organization at Denver. Elsewhere in this issue is an abstract of a paper by Mr. C. N. Stannard, secretary of the Denver company. This was one of those written for the Co-operative Electrical Development Association last spring. It is fully abstracted in this issue not because the scheme of organization described has not been previously dealt with, but because it serves to put into convenient and compact form an outline of a new business department organization which has been adopted by a formidable array of allied companies scattered over the country. Mr. Stannard has had an important part in the actual work of perfecting the first or parent organization of this kind, from which the numerous others have been patterned. His paper, therefore, deals with practice and experience, rather than with theory.

THE STANDARDIZATION OF ARC LAMPS.

In view of the present great interest in this matter, stimulated perhaps by the Colorado Springs litigation, the formal action of the German Electrotechnical Society reported in a recent number of the *Elektrotechnische Zeitschrift* is very much to the point. It is practically the same as tentatively adopted some time since, and we commend it to the National Electric Light Association, not at all as a finality or as in any way binding upon American engineers, but as a precedent that cannot properly be ignored. As our readers are already aware, our German confrères have come squarely out for the mean lower hemispherical rating in hefners. Most American engineers will shy at this proposition, but have they a safer course to propose? The mean lower hemispherical rating certainly measures with sufficient precision that part of the luminous output which is available for street lighting. It does not, however, take into account the character of the distribution and is therefore faulty from the standpoint of illumination, which is after all the thing by which successful lighting must be judged. Some engineers go so far as to hold that the illumination itself is the thing to be measured, and that the arcs should be rated by, let us say, their power of producing a certain illumination at a specified distance. This is practically rating them with reference to their nearly horizontal rays.

Either of these propositions is likely to lead to unfair comparisons between different types of lamps, and for this reason we believe that neither of them really meets the requirements. The mean lower hemispherical rating favors unduly lamps which, like the flaming arc, give an immense flux of light nearby and relatively weak horizontal rays. The minimum illumination rating is, baldly, legislation in favor of the magnetite arc and its kin, which throw their main flux near the horizontal and are lacking in that brilliancy near the lamp which is often desirable, especially in the more densely inhabited parts of cities. A street lighted on a specification of, say, 0.02 foot-candle minimum, might, and often would, be badly lighted as a whole. It has been the uniform experience that whenever a rating has been set up ingenuous persons are always ready to meet its letter while dodging its spirit. On the other hand, the mean lower hemispherical rating might easily lead to still worse abuses. In our judgment both these ratings have gained simplicity at the expense of even-handed justice. Illumination is in a sense the proper logical basis for rating, but not when applied merely as a minimum. A specified minimum is extremely likely to act in favor of small units, and we fancy the Welsbach street lighting contingent would like nothing better than to have public attention concentrated on the attainment of a fixed minimum illumination. The electrical engineers operating on this line would be "hoist with their own petard" with a vengeance. As a matter of actual every night practice, minimum illumination alone is not a proper criterion of good lighting.

It is an open question indeed whether illumination as such, however considered, is really the thing to be measured in the

field. The experience thus far with instruments which purport to measure illumination has been very unsatisfactory. To advise their commercial use would be hunting litigation. In experienced hands some forms of illuminometer may be made to give trustworthy approximations, but placed at the service of those unfamiliar with them they would usually lead one astray. Arc-light photometry is difficult under the most favorable conditions, and upon the street it is well-nigh impracticable.

The German society advises certainly the best two methods of arc photometry, the double-mirror method giving two sides of the arc simultaneously, and the use of the Ulbricht sphere. The former applied as advised to obtain readings at 10 degrees apart gives the most reliable distribution curves for the arc yet to be obtained, and such curves can serve as the basis for computing values of the mean illumination at different distances far more likely to be correct than those measured directly on the street. It is highly desirable to improve average street illumination. There should certainly be a specification of the minimum and it seems also to us that there should be a specification of the average illumination over the area covered up to the lamp. This double requirement would favor lamps which give good distribution without ignoring the value of general brilliancy. And we are inclined to believe that the illuminations should be computed from the photometric curves rather than measured under the rapidly varying conditions of street service. The personal equation always present in photometry is enormously increased in field measurements of illumination.

The Household Motor.

It is gratifying to note recently the number of towns where small motors for household purposes are being introduced by the central station company. The principal use of the household motor at present is in driving washing machines and ice cream freezers. The greatest difficulty in the way of their introduction is the high first cost of a good motor of sufficient capacity to drive a washing machine. The fact is there are a great many uses about the ordinary household to which a motor could be put, and what is needed just now more than anything else is some scheme whereby it will not be necessary for the house owner to invest in a lot of different motors for various purposes. While it may not be possible to arrange motors so that one motor can do any of the work around the house for which a motor should be called on, it certainly seems as if the number should be reduced materially from that at present necessary if it is to be a general household convenience.

Taken as a whole the household motor list at present is quite a long one. To begin with, there is the fan motor for summer, the necessity for which varies considerably according to the latitude and the location of the house. Then there is the fan motor for use in connection with the hot air furnace in the winter, as described several times last winter in these columns. In northern latitudes this is a much greater boon than the summer fan and will bring more revenue, and the same fan motor can obviously be used for both these purposes. A motor of about ¼ horse-power is usually considered necessary to operate a washing machine or an ice cream freezer. There is the sewing machine motor, which must be attached to the machine, and in many cases there is the motor for operating the small house pumping system where there is no water works system or where the water works system is inadequate to maintain the pressure on the upper floors. Household dough mixers and meat cutters are seldom motor-driven, but might well be if matters could be conveniently arranged. Then there is the possible use of the fan motor for polishing silver. Now, a certain number of these can be operated by the same motor if it is belted to a short line shaft, while some require the motor to be at a particular spot, so it is a question of moving the motor or the appliances to be driven if the same motor is used for various purposes or of buying a separate motor for each kind of service. It is now time for central station ingenuity to get busy devising plans for getting the greatest possible variety of uses out of one or two motors. For example, two motors should be sufficient for most households—one being stationary for doing heavy work and the other portable for driving the fan, the sewing machine and the polishing and grinding wheel, as required. No great advance can be expected until some ready-to-use combinations of this kind have been devised and put on the market. The user, unless he is of a very mechanical turn of mind, is not going to bother to get up these combinations himself.

Illumination and Some Illuminants.

An abstract of a paper on the above topic, read by Mr. John D. Mackenzie, in April, before the Glasgow Section of the Institution of Electrical Engineers, has recently been published in the London *Electrical Review*, and is noticed elsewhere in the Digest. The paper contains useful data for the illuminating engineer, and points to a number of cardinal principles in electric lighting. The intrinsic brilliancy of various illuminants is given approximately in terms of candles per square inch. Converting these in round numbers to the square centimeter, the Moore tube comes lowest with about 0.2 candle-power per sq. cm. of active visible surface, then the paraffin candle with 0.5 next, the mercury vapor lamp with 1, next the incandescent gas burner with 5, next the acetylene gas burner with 15, then the carbon filament incandescent lamp with 40, then the metallic filament lamp with 80, and finally the Nernst lamp with 150 candles per square inch.

A table of reflective coefficients is given which shows the wide range of reflective power possessed by different substances. The reflective coefficient for highly polished silver heads the list at 92 per cent; while black velvet brings up the rear at 0.4 per cent. Consequently, polished silver only absorbs 8 per cent of the light incident upon it; while black velvet absorbs 99.6 per cent. The paper points out that although artificial light in dwelling rooms should be largely diffused, perfect diffusion must be avoided. This is for the reason that if there be insufficient diffusion, the shadows of objects will be glaringly and distressingly obtrusive, suggesting the blue quartz moonlight of the melodramatic stage. If, however, the diffusion is complete, all shadows will disappear, and the observer will be perplexed by absence of contrasts, and the difficulty of distinguishing objects, or their relative distances. The happy mean to be aimed at by the illuminating engineer between too little diffusion and too much diffusion, suggests

the explanation once offered to an engineer as to the meaning of *quasi* in the term quasi-criminal; namely, both "of the nature of" and "not of the nature of," but rather more of-the-nature-of, than not-of-the-nature-of. The fact is that we are compelled to imitate sunlight which, as it enters our rooms, is largely light direct from the sun and from the windows, and yet is also largely indirect, in scattered and diffused sky light, and light reflected from neighboring bodies.

The paper also calls attention to the fact that the illumination should not exceed a certain limit. The tendency in recent years has been to increase illumination everywhere. It is alleged that the effect of this is seen in the alarming increase in ophthalmic disease. Assuming, however, that ophthalmic disease is admittedly increasing, at least a share of the increase may be claimed for the increasing strain on the eyes in early life, under increasing pressure of general education by book reading. The suggestion is made that in domestic lighting, high-efficiency incandescent lamps should be arranged in straight tubes, or reflecting troughs, along and behind deep frieze mouldings. By placing these lamps in series groups, their low-voltage requirements could be met; while, by suitable switches, the number of groups turned on could be adjusted for the amount of illumination needed. It is certainly very desirable that naked lamps should be removed from direct vision, not so much on the promptings of modesty, as on the claims of comfort and ophthalmic hygiene. Lamps should give light to see by, but should not be seen by their light.

TRUE CENTRAL-STATION PROSPERITY.

Not infrequently we hear of large increases of central station business without particular effort on part of the management, and it may be worth inquiring if central-station growth of this kind always indicates real prosperity. Mere growth of the peak load from year to year, without change in the general character of the load, does not, for example, necessarily indicate a prosperous condition. Such growth may actually mean that the company is obliged to add, year by year, to an investment which is paying none too well and that the ratio of earnings to investment may not be improving. If the central-station property is being developed as it should be, the ratio of gross earnings to investment should be steadily on the increase from year to year. Going a step farther back, this practically means that the ratio of average load to peak load or, in other words the yearly load factor, should be steadily increasing. There is at best in the central station business a large amount of investment idle 22 hours per day from six to eight months of the year. The greater the number of hours this investment can be made to earn revenue, the greater will be the ratio of gross revenue to investment. There are few central stations where a load that is turned on an average of only one hour per day during the station peak load involves fixed charges of less than 10 cents per kw-hour. In most larger stations it will amount to more than this. It is therefore evident, without going further, that with rates as they are at present the country over, most of the dividends must be paid from load which is on at other times than at the peak.

But it has been a peculiar fact in connection with the electric-lighting business that it is the peak load customers using electricity but a short time per day, who have come to the central station most easily and cling to it most persistently; while the customers using electricity many hours per day have been those most prone to adopt other sources of light and power. This fact does not seem to have been generally recognized by the central-station industry, but it is generally true, and when generally recognized, it cannot fail to have beneficial results. The reason that the peak load or unprofitable class of business comes most naturally to the central station in many cases is due largely to radical defects in rate systems in the past and in the general policy of many central station companies. Such companies have failed to recognize the relative value of long and short-hour business; or at least if they have recognized it they do not act accordingly in adopting rates. While charging a rate which is barely sufficient to cover the fixed charges of the short-hour users, they fail to make adequate concessions to the long-hour users. Now the man who wants light only a few hours per year and that during the peak will naturally go to the central station company for service, because his bills will not be very high anyway and he could not begin to afford to go to the expense of putting in an isolated plant or of submitting to the nuisance of kerosene lamps or a gasoline plant for the sake of economy. If he is using electricity many hours per year, however, and is charged as high a rate as a man with the same number of lamps used only a few hours per year, his bills soon run up to a point where he begins to think of some other method of illumination.

The same general principles apply to power users. A man who wants only a little power at rare intervals can afford to pay a higher rate for the sake of convenience; but if he is a steady eight or ten-hour per day user and the rates are high, his business is likely to be lost to steam or gas engines. We thus see the truth of the assertion that it is the most unprofitable business which naturally stays by a company, while it takes effort to get the profitable class. Such effort must begin by the adoption of a proper rate system which will give long-hour users the low rate to which they are entitled, and must be followed up with persistent solicitation to secure the more profitable business. It is on this long-hour business that the efforts of the solicitor and advertising man should be concentrated. While it is doubtless true that unprofitable peak-load business should be taken for its advertising value, it should never be considered as any great revenue-producer, but simply as an entering wedge for the electric light. The most undesirable class of business is from the store or office which closes regularly at six o'clock or earlier and requires but little or no artificial light during the day. About the only hope of making some store lighting profitable is to get show-window and sign lighting to be run after closing time. Residence lighting when secured in large enough quantities is likely to be more profitable, especially with the introduction of the various home conveniences now being pushed actively. It will average up better as to hours use than commercial lighting. Power business is, of course, the principal salvation of the central-station company in many places. If the power is not to be had about the only hope for increasing the load factor lies in an increased use of heating appliances, fan motors and the like and in more display lighting. There are comparatively few places, however, where the company has anywhere near all the power business in sight.

The Statistics of Electrical Development.

Bulletin 73, just published by the U. S. Bureau of the Census, is a report on the manufacture, according to the census of 1905, of electrical machinery, apparatus and supplies, by Mr. T. C. Martin, expert special agent. In 1905 there were 784 establishments engaged primarily in the manufacture of electrical machinery, apparatus and supplies. Their capital was $174,066,026; the average number of wage-earners employed, 60,466, and their wages, $31,841,521; the cost of materials used, $66,836,926; and the value of products, $140,809,369. There have been increases since 1900 in all items, even in the number of establishments, an item which in most industries has been reduced by the general tendency toward consolidation. The percentages of gain are as follows: In number of establishments, 34.9 per cent; in capital, 108.1 per cent; in number of wage-earners, 43.9 per cent; in amount of wages paid, 54.7 per cent; in cost of materials, 35.1 per cent; and in value of products, 52.3 per cent. In addition to the products reported by these establishments, there was an output of electrical machinery and supplies, valued at $18,742,033, from 128 establishments engaged primarily in other lines of manufacture.

The distribution of electrical manufacturing throughout the states has remained the same in all essential respects at the two censuses. New York, Illinois, Ohio, Pennsylvania, Massachusetts, Connecticut, Indiana and New Jersey reported 631 of the 784 establishments making electrical apparatus at the census of 1905 and products valued at $126,807,804, or 90.1 per cent of the total for the country. In value of products New York led, followed by Pennsylvania, Illinois, Massachusetts, New Jersey and Ohio in the order given. Their combined product constituted five-sixths (84.5 per cent) of the total value of products. Connecticut and Indiana did not reach the $5,000,000 mark.

The increase in total capital was distributed uniformly throughout the country, but was greatest in Pennsylvania, where capital increased from $20,967,587 to $58,393,011, or 178.5 per cent, although the value of products advanced only from $19,112,665 to $26,257,569, or 37.4 per cent. The capital and value of products of the other leading states were as follows: New York, capital $30,643,167, and products, $35,348,276; Illinois, capital, $21,644,783, and products, $16,700,027; Massachusetts, capital, $12,735,427, and products, $15,882,216; New Jersey, capital, $18,457,821, and products, $13,803,476; and Ohio, capital, $10,408,184, and products, $11,019,235.

The total value of dynamos and motors, which constitute the largest single class of electrical apparatus manufactured in the census year, was $33,454,860. A slight increase in the value of all dynamos (from $10,472,576 in 1900 to $11,084,234 in 1905) was associated with a very large increase in number (from 10,527 to 15,080) and in capacity (from 770,832 horse-power to 1,328,243 horse-power). It is obvious that a relatively small increase in the average size of machines was accompanied by a large decrease in the cost per horse-power to the purchaser.

Of the total number of dynamos, 13,756, having a capacity of 853,800 horse-power and a value of $6,973,130, were direct current and 1324, with a capacity of 474,443 horse-power and a value of $4,111,104, were alternating current. The number, horse-power and value of the direct-current dynamos were greater in 1905 than in 1900, whereas the alternating-current dynamos increased in capacity only. Closely associated with the dynamo class is the group comprising double-current generators, dynamotors, motor generators, boosters and synchronous converters, of which there were in all 2135 having a combined capacity of 279,552 horse-power and a value of $1,740,534.

The value of motors built was $22,370,626, twice as great as that of the dynamos. Of this, $13,120,948 represents the value of 79,877 stationary motors (54,242 direct current and 25,635 alternating current), with a combined capacity of 678,910 horse-power. There have been increases in the number, horse-power and value of both kinds of stationary motors, of motors for fans, and of miscellaneous motors. Those designed for railways and automobiles, on the other hand, have decreased in number and value, but have increased in horse-power. The increase in the average size of the electric automobile motor is due to the more general use of the electric automobile for industrial purposes.

In 1905, 66,698 transformers were manufactured, having a capacity of 970,908 horse-power and a value of $4,468,567. The production of transformers has nearly doubled in the five-year period, testimony to the growing use of alternating current for lighting and power purposes. More than half the capacity of the transformers, namely, 504,009 horse-power, was comprised in transformers, 3387 in number, which had a capacity of 50 kilowatts and upward. The effect of size on price is seen in the fact that these larger transformers were returned as valued at $1,176,360, or slightly over $2 per horse-power, a low figure as compared with the price of the 63,311 under 50 kilowatt capacity.

The value of switchboards intended for electric light and power and electric railway work has advanced from $1,846,624 in 1900 to $3,766,044 in 1905. Marble and slate as materials have generally supplanted wood, which at one time was universally used even on boards for currents at high voltage.

Batteries and their parts and supplies manufactured in 1905 had an aggregate value of $4,243,893, as compared with $3,679,045 in 1900. The actual product was probably greater because their various elements are not always distinguishable as battery parts, and are therefore sometimes returned as "all other products." Of the aggregate, $2,645,749 represents the value of storage batteries, parts and supplies; and $1,598,144 that of primary batteries, parts and supplies. Of primary batteries, 1,734,801 were liquid and 4,888,361 dry; the values of the two kinds were about equal.

The value of all classes of carbons reported for 1905 was $2,710,935. Although the total is more than one-half greater than in 1900, there was a falling off of over $200,000 in arc-lamp carbons, due to the adoption of the modern inclosed arc lamp, which requires recarboning much less frequently than the open type, and to the introduction of a new variety of lamp of the luminous arc type, the magnetite, which dispenses entirely with the carbon.

The number of arc lamps made in 1905, 195,157, was greater than in 1900, but their value, $1,574,422, was less by $253,349. A remarkable change has taken in place in the relative importance of the two types—open and inclosed. The production of the former fell from 23,656, with $276,481 value, to 1748, valued at $29,989; whereas the number of inclosed lamps advanced from 134,531 in 1900 to 193,409 in 1905. The large number of the latter has brought with it a reduction in cost, the value declining from $1,551,290 to $1,544,433. In addition to these arc lamps 1924 search lamps and projectors, valued at $114,795, were made in 1905, a decrease since 1900 of 77 per cent in number and of approximately 50 per cent in value.

One of the largest specialized departments of electrical production is that of incandescent lighting. Incandescent lamps are made all over the country, but the largest output is from a plant in New Jersey. The total value has risen from $3,442,183 to $6,308,299. The principal gain both in quantity and value was in 16-cp lamps, which remain the standard, and advanced from 21,191,131 to 83,333,285 in number, and from $2,910,023 to $4,608,084 in value. A radical advance in this branch consists in the production of incandescent lamps with metallic filaments in place of carbon. Tantalum, osmium and tungsten are used for this purpose.

The total number of decorative and miniature lamps, etc., in which class are included also vacuum tubes, vacuum and vapor lamps, and X-ray bulbs, was 1,584,495 (about four times the number made in 1900) and their value was $644,906, as compared with $72,935 in 1900.

Electric lamp fixtures to a total value of $5,305,466 were made in 1905, a considerable increase over 1900. The increase is accounted for to a great extent by the larger manufacture of sockets and bases incident to incandescent lamps, but the bulk of the amount, $3,294,606, represents, as before, the fixtures themselves. The introduction of electric lamps of new forms

has involved the manufacture of forms of fixtures unknown at the census of 1900.

The total value of telephonic apparatus manufactured, as reported at the census of 1905, was $15,863,698, as compared with $10,512,412 for the census of 1900. Of this total value, $824,204 represented the value of 850,815 transmitters; $696,113 the value of 831,195 receivers; $6,483,418 the value of 887,447 complete sets of instruments; $68,826 the value of 4560 interior systems complete without instruments; $5,154,447 the value of 4283 central switchboards; $564,795 the value of 3917 private exchange boards; and $2,071,895 the value of telephone parts and supplies (chiefly the signaling apparatus in magneto-telephone sets and the line protector fuses, etc.).

Illinois is the great center of telephonic manufacturing industry in the United States, both as to total number of factories and as to output. More than half the total product, or $8,357,521, was from this state. The output of New York was also large, but not quite half that of Illinois.

An apparent falling off in the production of telegraph apparatus from $1,642,266 in 1900 to $1,111,194 in 1905 is accounted for in part by the growing custom among the larger telegraph systems of manufacturing and doing the repair work on their own apparatus.

The value of the factory product in 1905 is distributed thus: 76,826 intelligence instruments (key, sounder, etc.), valued at $187,744; police, fire, district and miscellaneous, valued at $592,070; wireless telegraph apparatus, valued at $114,050; and switchboards and parts and supplies, valued at $217,330.

Long Test for Southern California Power Plant.

Considerable interest is being taken on the Pacific Coast in the unusual conditions of test laid down for the acceptance of the power plant being erected by the Pacific Light & Power Company at Redondo, Cal., near Los Angeles. There was severe competition for the contract at the time it was let and much objection was made to some of the stringent conditions of the specifications. The contract was awarded to Chas. C. Moore & Company, engineers, of San Francisco, and called for three 5000-kw General Electric alternators, each directly driven by a double compound McIntosh & Seymour engine, Babcock & Wilcox boilers, and the necessary condensing apparatus, pumps, auxiliaries, etc.

In accordance with the contract guarantee terms the contractors agree to deliver 160 kw-hours at the switchboard for every barrel of fuel oil. The oil is to be considered as having a heating value of 18,850 B. T. U. per pound and proper allowances are to be made for temperature and other factors entering into the test. The test is to be conducted continuously for 90 days and if the contractors fail to deliver the required load they forfeit a certain sum per kilowatt. Likewise, if they run above the 160 kw-hours per barrel, the power company is to pay a similar bonus. The maximum of either forfeit or bonus is $50,000. The test will cover the entire plant as may be judged by the conditions, but as the guaranteed efficiencies of the generators are to be taken from the General Electric Company, the test actually resolves itself into an efficiency test of the boilers and engines, including of course their auxiliaries and is naturally attracting much attention from engineers on the Coast.

As this is to be the first 90-day test on the Pacific Coast, and on account of the prominence of the power company in the Southern California field and of the contracting engineers, much interest is being taken in the outcome. Another interesting point also is that the steam turbine builders would not accept certain of the conditions of the contract, so that the reciprocating engine is thus put on trial to demonstrate its suitability for this class of power station work.

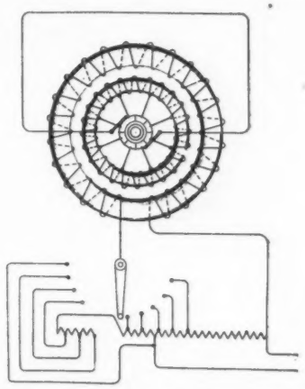
The tests will be conducted under the supervision of a board of engineers consisting of C. R. Weymouth, chief engineer of Chas. C. Moore & Company; Mr. Cobb, engineer for the Pacific Light & Power Company, and Prof. C. L. Cory, of the University of California as neutral arbiter. Assisting Prof. Cory will be Prof. Joseph N. Le Coute and G. C. Noble, both also on the engineering faculty of the University of California. Prof. Le Coute will pay especial attention to the mechanical end of the tests as well as prepare the plan and working outline for conducting the test. Mr. Noble will have charge of the electrical details.

Another interesting feature is that the contractors are under forfeit to start up the first generating unit by a certain date. This date has been advanced considerably due to delays caused by the power company, and it is expected that this condition will be met satisfactorily as the plant is now nearing completion.

The power plant is intended as a large auxiliary station to help out the water-power and steam stations of the Pacific Light & Power Company and will also feed into the supply system of the Huntington electric railways. It is located on the shore of the Pacific Ocean, so that condensing water is available.

Starting Device for a Repulsion-Induction Motor.

The accompanying illustration shows a starting device for use with a repulsion-induction motor for which a patent was granted on April 30 to Mr. W. A. Layman. The motor is of the Wagner type, which starts as a plain repulsion motor and is converted into an induction motor by a centrifugal device when the rotor attains full speed. The inventor has arranged to impress upon the primary terminals of the motor an e. m. f. which can be so varied that the torque of the rotor can be held practically constant from standstill to normal speed. There is connected across the supply leads a specially-designed transformer which is used as a so-called auto-transformer with one



ALTERNATING CURRENT MOTOR STARTER.

section reversed, as shown in the illustration. At starting, the controller arm rests on the intermediate contact of the auto-transformer winding. The voltage is gradually raised as the speed increases by moving the controller handle manually until an e. m. f. greater than normal is obtained at a speed somewhat less than synchronism. A further movement of the controller arm places it upon a contact of the auxiliary coil, whose voltage is opposed to that of the main coil. The further rotation of the arm finally brings it to the last contact, thereby gradually reducing the voltage to the normal operating value and completely cutting the auto-transformer coil from the motor circuits, when the centrifugal device converts the machine into an induction motor.

The leading claim, which seems to cover all variable-voltage starting schemes now in use, is as follows: The method of operating an alternating current motor, which consists in starting said motor on a voltage below normal operating voltage, and raising said voltage before normal running speed under load is attained.

Chicago High-Tension Transmission Meeting of the A. I. E. E.

A special high-tension transmission meeting of the American Institute of Electrical Engineers was held at the Auditorium Hotel, Chicago, May 24. The sessions, which were presided over by Mr. Paul M. Lincoln, were well attended, from 150 to 200 being present.

The first session was called to order soon after nine o'clock by Prof. P. B. Woodworth, chairman of the board of managers of the Chicago branch of the Institute. He made a few introductory remarks as to the character and object of this special meeting of the Institute, and announced an excursion on the following day for those who wished to visit the 66,000-volt transmission system of the Grand Rapids-Muskegon Power Company near Grand Rapids, Mich.; this being the highest voltage plant yet put in commercial operation. It was announced that the party would leave Chicago at 8 p. m. that evening by boat for Holland, Mich., where early in the morning cars would be waiting to take the party to Grand Rapids for breakfast, from which point the trip would be made to a power house and sub-station of the Grand Rapids-Muskegon Power Company at Croton dam and Grand Rapids. The Grand Rapids-Muskegon Power Company would entertain the party at lunch at one of its power houses, the Chicago members returning by boat, Saturday evening.

Mr. Lincoln then assumed the chair and announced the reading of a paper by Mr. H. W. Tobey on "The Relative Merits of Three-Phase and One-Phase Transformers." In the absence of the author, Mr. W. S. Moody read this paper. A paper on the same subject by Mr. John S. Peck was read in the absence of the author by Mr. J. W. Farley. The subject was then discussed at length by Messrs. A. H. Pickler, P. Junkersfeld, C. W. Stone, W. S. Moody, P. D. Wagoner, E. N. Lake, K. C. Randall, H. B. Gear and A. S. McAllister. Mr. R. P. Jackson read a paper on "Potential Stresses as Affected by Overhead Grounded Conductors," analyzing from the theoretical side the measure of lightning protection afforded by such conductors. This paper was ably discussed by Messrs. D. C. Jackson, Paul M. Lincoln, Morgan Brooks and J. W. Andree. At this point a recess of about 25 minutes was declared in order to allow members to register and secure tickets for the luncheon tendered by the Chicago branch of the Institute to members and visitors.

After the recess, further discussion of the question of grounded overhead conductors was participated in by Messrs. H. C. Hoagland, George A. Damon and P. M. Lincoln. Mr. C. C. Chesney's paper on "Forced Oil and Forced Water Circulation for Cooling Oil-Insulated Transformers," was read by Mr. C. W. Stone and discussed by Messrs. Stone, Farley, Moody and Lincoln. The meeting then adjourned for the lunch at the Auditorium Annex, which proved to be a very enjoyable affair for the furthering and renewing of professional acquaintance.

After luncheon the afternoon session was called to order at 2:45 and a special vote of thanks was passed by the out-of-town members to the Chicago branch for its entertainment. A communication was read from Mr. George E. Hayler, superintendent of the Spring River Power Company, Joplin, Mo., on the use of overhead ground wires on that company's system. Mr. James Lyman reviewed some information obtained from a recent visit to Butte, Mont., and from conversation with Mr. Max Hebgen, manager of several transmission lines running into Butte. All these experiences were favorable to the use of properly installed overhead ground wires as a protection from lightning.

A paper under the head of "Enclosed Station Wiring," by F. O. Blackwell, was read by Mr. Moody and led to a rather amusing discussion between Messrs. Lincoln, Stone, Hoagland, Mahrberg and Jameson on the advisability of enclosing very high potential conductors with fire-proof barriers inside of power plants and sub-stations.

Mr. H. E. Niesz, in behalf of the Commonwealth Electric Company, of Chicago, invited members to visit the Fisk Street station after the adjournment.

The program for the trip to the Michigan transmission plant was carried out as outlined above, about 50 making the excursion. The Grand Rapids-Muskegon Power Company enjoys the distinction of holding the present record for high operating voltage; the power station voltage having reached 71,000 at times during the last year, and being normally 66,000. A description and map of this company's extensive system, with illustrations of the transmission line appeared in the ELECTRICAL WORLD of Nov. 3, 1906. The company is now taking over control of the Grand Rapids Edison Company, to which it has been supplying power and which has an extensive distributing system in Grand Rapids. The Croton dam power house, which is nearing completion, was the one visited. The hydraulic work was in good shape for inspection. An excellent lunch was served at the company's construction force dining room.

Mr. F. E. Greenman represented the power company in piloting the party and explaining the work, as Mr. A. J. Bemis, general manager, was too much occupied with important business in connection with the coming consolidation with the Grand Rapids Edison Company. Mr. Jas. B. Foote, electrical engineer, also was obliged to send regrets. A number of officers and stockholders, however, joined the special car at Erwin; these being Mr. Thomas Hume, of Muskegon, president; Mr. David L. Edwin, of Muskegon; Mr. J. G. Emery, of Muskegon, treasurer; Mr. H. N. Hovey, of Detroit; Mr. Harry Sawyer and Mr. William Monroe.

Returning to Grand Rapids late in the afternoon, the party found a special street car waiting to take it to the receiving sub-station in the edge of town where 66,000-volt current was being received and transformed to 6600 and 19,000 volts; the former for use in Grand Rapids at sub-stations and by wholesale power users, and the latter for feeding into the transmission lines of two interurban railways.

The arrangements for the trip were made by Mr. Geo. A. Damon, of the Chicago branch of the American Institute of Electrical Engineers, and the occasion proved to be a very fitting close to the high-tension transmission meeting.

Hearing on Boston Edison Rates for Electric Service.

A continued hearing on the rates of the Edison Electric Illuminating Company, of Boston, concerning which an article appears on page 1090, was held before the Masachusetts Gas & Electric Light Commission on May 22. The morning was given up to the arguments of representatives of the Public Franchise League against the answers made by the Edison Company to questions asked by the League at a previous hearing, and the principal speaker was Mr. John B. Eastman. Mr. Eastman submitted a long statement condemning the Wright demand system and urged that the company allow its customers the option of taking energy at a flat rate of 10 cents per kw-hour.

Mr. E. W. Burdett, for the Edison Company, emphasized the desire of the company to co-operate in all reasonable ways in furnishing the Public Franchise League with the information which it desires, and brought out the need of the interested parties getting closer together if real progress is to be made. He questioned Mr. Eastman closely as to the exact nature of the changes which the League proposes, with the result that Mr. Eastman admitted that the only definite change desired by his clients was the establishment of the flat rate as an alternative to the differential system of charging now in vogue. Another hearing will probably be held about the middle of June, at which the Edison Company expects to meet in detail all the points raised in the hearing of May 22, and to state its side of the problem of determining the proper rate in the light of recent inquiries.

Meeting of Purdue Branch A. I. E. E.

The last and perhaps the most enjoyable meeting of the Purdue Branch A. I. E. E. for this year was held on the evening of May 14 in the lecture room of the Electrical Building of the university. Quite extensive preparations were made for this meeting and the promoters were in no way disappointed. The attendance was good and a general feeling of satisfaction existed. Mr. G. H. Kelsay, superintendent of motive power for the Indiana Union Traction Company, was the speaker of the evening, his subject being, "Organization and Methods in the Operation of the Mechanical and Electrical Departments of Interurban Railways." He handled his topic fully, dividing it into four principal parts. First, that of the organization in general. Here he dwelt at length upon the extent of the organization for plants of various size, giving actual cases as examples. Second, methods of operation and handling of men and equipment. Third, maintenance of power plant equipment, etc.; and fourth, high tension line construction and repairs.

Mr. Kelsay exhibited several forms and charts upon which the different employees report the results of their labor or the performance of their machinery. An accurate record is kept of everything of importance so that at any future time comparisons may be made and policies outlined. After the principal discussion, many questions were asked covering the most important phases of the talk. This part of the programme proved to be exceedingly instructive to all.

Retiring Vice-Chairman G. B. Walker then took the floor and after thanking the branch for their support during the year, turned the office over to Mr. R. H. Webb, vice-chairman elect, who made a few remarks relative to his plans and policies for next year. After a short business session, the sliding doors leading into the main laboratory were thrown open, revealing a very pretty arrangement of cups, spoons and all the paraphernalia necessary for a "feed," which was most heartily enjoyed by all. The annual report of the executive committee showed a most prosperous year for the branch, the membership having been increased over the preceding year by 96.8 per cent with an average attendance at the meetings of 98.

The retiring officers are: Glenn B. Walker, vice-chairman; Francis H. Bagley, assistant secretary; Chas. H. Hansell, treasurer; Oscar C. Warner, chairman telephone section, and Frank J. Strassner, secretary of the telephone section. Prof. C. P. Matthews, chairman, and Prof. J. Walter Esterline, secretary, hold over.

The German Electrical Industry.

While the year 1906 has been the most active in the history of the German electrical industry, from the financial standpoint the net result falls behind that of the preceding year. Owing to the recent consolidation of interests, there has been more stability, the abnormal activity which led to the break-down of several years ago being now kept in check.

The larger production of the greater establishments has been due less to increase in the number of workmen in separate establishments than to the attempt of the larger ones to extend their manufacture to as many branches as possible of electrical work. While formerly there were only two very important companies which in their own workshops produced nearly all the articles needed in their own manufacture, more recently there has come into the field a third, which by buying out smaller special factories and reaching out into new fields of industry, seeks to make for itself a similar complete circle of work.

Despite the various unfavorable features, such as high rate of interest and a hitherto unknown increase in the price of the raw materials—and indeed at times a lack of such raw material—which in the last year threatened the financial development of the industries, these have no permanent undesirable influence.

It has been principally the mining industry which has been in the market for electro-technical machines and apparatus. The increased production of the industry has naturally been accompanied by an increase in the number of workmen and employees, which, while it in 1905 amounted in round numbers to 82,000 and in 1905 to 95,000 in 1906 reached 100,000. The working capacity has also been increased. The thirty-two stock companies in the field have increased their working capital by 85 million marks, so that there are now employed in electrical manufacturing about 710 million marks, as against 625 million in 1905. If there be added to this the money invested in electric plants—as for instance light and power stations and electric railways—it may be safely said that to-day the entire electro-technical industry has in use two and three-quarter billion of marks ($654,500,000).

Despite, however, the foregoing figures and facts, which make so favorable a showing for the quantitative capacity of the electro-technical industries, the fact remains that from a business point of view the results of the past year fall behind those of the preceding one. An increase of the financial productivity of the works has been prevented by the rapid and unpreventable increase in the price of the principal raw materials. In the presence of such prices the electrical industries find themselves in a position from from favorable, notwithstanding a receptive market for their products.

Boston Franklin Fund.

An indignant correspondent in the New York *Sun* protests against the most recent action of the trusfees of the Boston Franklin Fund. In his will Franklin left £1,000 each to Boston and Philadelphia, the proceeds to be reinvested during a century; at the end of a century $155,000 of the accumulation was to be reinvested for another century. Franklin, who died in 1790, calculated that at the end of the first century the value of each fund would be $655,000, and that the $155,000 to be reinvested would grow to about $20,000,000 at the end of the second century. At the end of the first century the Philadelphia fund through mismanagement only reached $87,600.29; the total value last year was $159,000. The Boston fund last year amounted to about $400,000. Franklin directed that the portion of the Philadelphia fund available at the end of the first century was to be devoted to supplying the inhabitants with pure water. In fact, his wishes as to reinvestment are not to be carried out, and the entire fund was appropriated seventeen years ago to build a wing to an art building in Fairmount Park, which building has not yet been erected. The Boston fund available in 1890 was directed to be expended in public works, but the entire amount was appropriated some years ago to establish a trade school.

The letter referred to, after commenting on the illiberality of Boston in not furnishing the ground for a "half million memorial building" which it is now proposed to erect, proceeds as follows:

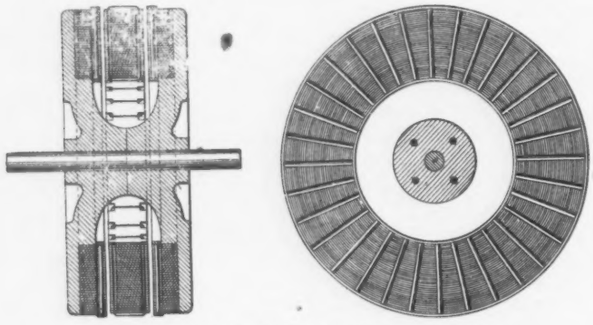
"Last year the trustees took $100,000 of the fund and bought an old tumbledown stable and some old shacks and razed them, and if the shade of old Ben Franklin could see the site, with its surroundings of dingy old rookeries, where his money is to be blown in, there is no doubt he would again call down lightning from the clouds to vent his just wrath at the indignity heaped upon his memory.

"Instead of taking the entire triangle of land that would have led to Tremont Street and making a small park, with the memorial building in the center, which would be an ornament to the city, these short-sighted, incompetent trustees selected a lot that will barely allow for the building, abutting on a narrow, ill-smelling alley and a narrow street, with the most unsightly and dilapidated surroundings possible, old stables, workshops and weather-beaten structures that a live building department would condemn in a jiffy.

"Poor old Ben! Those Boston people are certainly handing him a lemon. His memory is being gold bricked for keeps."

Induction Motor with High Power Factor.

For the purpose of decreasing the exciting volt amperes in an induction motor, Mr. Ralph D. Mershon, according to a patent issued April 30, provides a greater area for the interchange of flux between the stationary and revolving elements, thereby increasing the area of the air-gap with a resultant decrease in the reluctance of the magnetic circuit. Figs. 1 and 2 show what is considered the most advantageous form of the invention. The ring-wound stationary element is interspaced



FIGS. 1 AND 2.—SECTIONAL VIEWS OF MOTOR.

between two outer sections of the revolving element in order to secure a considerable air-gap area. The outer element has two faces adjacent to the sides of the inner ring, each provided with slots radially arranged in which there are conductors connected at their ends to short-circuiting rings. Each face, therefore, constitutes a short-circuited element analogous to the cylindrical form known as a "squirrel-cage." It is stated that this method of construction requires a much less magnetizing current than the ordinary to produce the same flux, so that a higher power factor may be obtained with the same amount of material in the machine.

Electrical Advancement in the Philippines.

Fort William McKinley, the principal fort and United States Army post in the Philippines, will shortly be electrified. About three years ago when the large power house of the Manila Railway & Lighting Company was erected in the city of Manila by J. G. White & Co., it was a matter of speculation whether our new possessions in the far east had reached the point of development to justify this undertaking. It is therefore pleasing to learn that the United States Government has recently placed a contract for an entire electric lighting equipment for Fort William McKinley, fed from the plant.

Although not perhaps so well known as some of those longer established in the States, this post when completed can lay claim to being one of the best appointed, from both a military and a practical standpoint, of any throughout the world. It includes the engineering, artillery, infantry and cavalry arms of the service, and these together with the medical staff, or about 4000 persons in all, occupy over 200 buildings, some of which are very large.

The post is supplied with water by artesian wells, a spacious ice and cold storage plant and fine buildings for entertainments, dances, etc. Its location is both attractive and advantageous, being situated on high rolling ground overlooking Manila and about six miles away, but connected therewith by a good macadamized road. In conjunction with the lighting installation which the Government has contracted for, the Manila Railway & Lighting Company will extend its railway line to the fort and will carry a three-wire 3300-volt transmission line to the central distribution station in the center of the reservation.

The distribution station will contain the switchboard and arc lighting apparatus and the secondary distribution from this point to the various buildings will be four-wire 220-volt two-phase. Each building will be supplied with a meter, distributing boxes, switches, etc. Westinghouse series arc lamps will be employed for street lighting and 6600 incandescent lamps will be installed for the interior lighting of the various buildings.

The Manila Railway & Lighting Company's power plant, which contains three 1000-kw and one 2000-kw Westinghouse-Parsons turbines, is interesting and strictly modern. Current is generated at 360 volts 60 cycles and stepped up to the line voltage. Babcock and Wilcox boilers, with superheaters, are used, also Alberger high-vacuum condensers; and the coal for all fuel used is shipped to Manila from New Castle, Australia.

The value of the contract which the government has placed with Messrs. German & Co., of Manila, for the lighting equipment is approximately $75,000, and Mr. F. H. Thompson has been sent to the States as representative for the purchase of the equipment. Mr. Putnam A. Bates, acting as consulting engineer to Morewood & Co., who are the export shippers, has prepared the specifications under which the bids have been taken and the orders will be placed.

Automatic Telegraphy.

A United States patent was recently issued to Albert C. Crehore and Major George O. Squier, U. S. A., on improvements in their well-known system of high-speed telegraphy. The object of the invention is to utilize a single phase alternating current for the transmission of telegraphic characters over a wire and the reception of the same by means of a neutral or polarized relay. The transmitter is operated in synchronism with a single-phase generator, a dash being produced by first transmitting a positive sinus or semi-cycle of the generated e. m. f. to begin the character, then suppressing the immediately following negative sinus and transmitting the next positive and the following negative sinus in succession, the latter operating to terminate the dash and clear the line. Spaces between the characters are produced by suppressing all positive half-waves, all of those of the opposite polarity being transmitted. A dot is transmitted by a single complete wave—a positive and negative semi-cycle. A succession of dots would, therefore, be transmitted by a succession of complete waves. The armature of the receiving relay, being polarized, is drawn to one side by the positive pulses and to the other side by the negative pulses. It is evident, therefore, that if the armature, under the influence of, say, a positive semi-cycle, is brought to the marking or recording stop of the relay, it will remain in that position so long as positive impulses only are being transmitted, or so long as negative impulses are suppressed. It will be moved over to the opposite or non-recording stop by the transmission of negative pulses and remain in that position under the influence of negative half-waves or by the suppression of positive half-waves. From this it is evident that by properly combining and suppressing the positive and negative half-waves, dots, dashes and spaces may be formed. The control of the alternating-current waves is entirely effected by means of the perforations in the transmitting tape. The specification describes in detail the perforations in the paper-transmitting-tape and their control of the alternating current waves going to the line; also the principal mechanical features of the system.

Spontaneous Ionization.

The May number of the *Philosophical Magazine* contains an article by N. Campbell giving an account of an experimental investigation of some curious observations of spontaneous ionization of a vessel which was being either heated or cooled. The saturation current through the gas in a vessel which was alternately heated and cooled was investigated. It was found that the current increased during the initial heating and decreased during the initial cooling. The circumstances which determine the magnitude of these changes were investigated. It is suggested that the changes may be due to the induction of electrification on the electrode by very massive charged particles carried about by convection currents.

CURRENT NEWS AND NOTES.

SEEING THE FALLS.—General Kuroki, the famous Japanese soldier, visited Niagara Falls on May 26 and made an inspection of the power plants that surround the great cataract.

THE FILING TIME.—The American Cotton Manufacturers' Association has taken action favoring an improvement in telegraphic methods, to the effect that the "filing time" be placed legibly on all dispatches. It is believed that this is often vitally important in business negotiations.

CHICAGO JOVIAN CLUB.—On May 16 the the Chicago Jovian Club presented with great success a clever operetta entitled "The Isle of Jove," written by Mr. Frank L. Perry, the well-known electrical journalist. The affair was of considerable advantage and benefit to the Sons of Jove.

PROF. ELIHU THOMSON presented a paper at the recent meeting in Philadelphia of the American Philosophical Society, on the subject of the Panama Canal. He expressed the opinion that the canal will be finished in eight or ten years. President Benjamin Ide Wheeler, of the University, has been tendered the presidency of the Massachusetts Institute of Technology, subject to confirmation by the corporation. President Wheeler has not stated that he would accept the appointment.

TELEPHONY IN VIRGINIA.—At Norfolk, Va., on May 21, the Virginia State Independent Telephone Association held its first annual convention and took steps looking to the establishment of a Virginia independent long distance telephone service. Forty companies were represented at the meeting and committees were named looking to the working out of plans and agreements for the construction of long distance connection all over the state. The officers of the organization are: President, Albert Parlett, of Bristol; vice-president, F. F. Marbury, of Alexandria; secretary and treasurer, B. L. Fisher, of Rocky Mount, Va.

INDEPENDENT TELEPHONE CONVENTION.—The International Independent Telephone Association will hold its annual meeting in Chicago at the Auditorium Hotel next week, beginning June 4, when a large attendance is expected. It is said that there is little probability that any discussion of an alliance of any kind between the independents and the Bell interests will come up at the meeting. The independents say that the Bell interests are not sincere in the offers supposed to be made and that they are presented unsigned by field representatives of some of the companies, rather than in a straightout manner by the officers. Even if so inclined, the independents would not consider offers of this kind.

CIVIL SERVICE POSITION.—The United States Civil Service Commission, Washington, D. C., will hold an examination on June 26, to secure eligibles for a vacancy in the position of chief engineer in the United States Post Office and Court House Building at Chicago, and for vacancies as they may occur throughout the country requiring similar qualifications. The salary of the position to be filled is from $1,800 to $2,500 per annum, and the entrance salary is $1,800. The age limit is 18 to 55. No application will be accepted from any one who is not a technical graduate or has not had at least two years' practical experience. In the examination, practical questions in mechanical and electrical engineering as to elevators, lighting plants, motors, wiring, etc., count for 65 out of a possible 100, and experience for 25.

SAN FRANCISCO BRIBERY.—In connection with the bribery charges at San Francisco against Mayor Schmitz and his confederate, Ruef, the grand jury has returned the following set of indictments: President Patrick Calhoun, of the United Railroads, fourteen; Thornwall Mulally, assistant to Calhoun, fourteen; Tirey L. Ford and W. M. Abbott, of the legal department of the United Railways, fourteen each; Mayor Eugene E. Schmitz, sixteen; Abraham Ruef, fourteen; President Louis Glass, of the Pacific States Telephone & Telegraph Company, two; Theodore V. Halsey, formerly an agent of that corporation, one. Other indictments had been brought previously. Heavy bail has been taken. Mr. Calhoun attacks Mr. Spreckles as trying to confiscate the traction properties and secure political control by these "unfounded" attacks.

NEW YORK ELECTRICAL SOCIETY.—On Saturday, May 25, the New York Electrical Society visited the power plant of the New York Central Railroad at Port Morris, on the Long Island Sound. About 300 members participated in this interesting trip. Before inspection of the plant, President Condict conducted a brief meeting at which Mr. E. B. Katte, chief engineer of electric traction, made a pithy address as to its leading features, and Secretary Guy presented nearly 50 names of candidates for membership. About two hours were then devoted to a thorough study of the plant, all details of which were open to view, and in regard to which a handy brochure full of data was distributed. The power house and switch house are the latest work of the kind and comprise four 5000-kw General Electric turbo units. The members were intensely interested in all that they saw. During the past three months the society has gained no fewer than 120 new members and new applications are being received.

THE N. E. L. A. CONVENTION.—All signs point to a very successful convention of the National Electric Light Association at Washington next week, beginning June 4, with headquarters at the new Willard. The programme is full of interest. Mr. George F. Porter, master of transportation, announces that a rate of a fare and one-third, on the certificate plan, has been secured from all points in territory of New England Passenger Association, Trunk Line Association (except points in West Virginia), Southeastern Passenger Association, Southwestern Excursion Bureau and the Eastern Canadian Passenger Association, for those attending the meeting of the National Electric Light Association, Washington, D. C., June 4 to 7. A special train of parlor cars will leave New York on Monday, June 3, 1907, via Central Railroad of New Jersey and Baltimore & Ohio Railroad, foot of West Twenty-Third Street, 8:50 a. m. (Liberty Street, 9 a. m.); Newark (Broad Street), 9:30 a. m.; Trenton Junction, 10:20 a. m.; Philadelphia (Twenty-Fourth and Chestnut Streets), 11:15 a. m.; Wilmington, 11:50 a. m.; Baltimore, 1:15 p. m., arriving at Washington, D. C., at 2 p. m.

A. I. E. E. AT SCHENECTADY.—The annual meeting of the Schenectady branch, American Institute of Electrical Engineers, was held on May 23, and was followed by a smoker. About 500 of the members attended and the meeting was a most enthusiastic one. The feature of the evening was the performance by the Edison Club orchestra, nearly all of whom are members of the local branch of the institute. The orchestra is composed of 20 pieces, and although it is the first time it has played in public, its selections were very well rendered. During the interval of the business meeting an election of officers for the ensuing year was held and reports were read. The report of the treasurer showed the total receipts for the year to be about $1,200, and of this amount there is a balance on hand of $733.88. Another report showed an increase in membership of from about 200 to more than 900 during the year. Nearly all the old officers were re-elected, and the following is the list: Honorary chairman, C. P. Steinmetz; chairman, D. B. Rushmore; vice-chairmen, E. H. Anderson, A. H. Armstrong, E. A. Baldwin, E. E. F. Creighton, William Dalton, G. H. Hill, E. B. Merriam, A. L. Rohrer, C. W. Stone; corresponding secretary, W. C. Andrews; recording secretary, J. M. Knox; treasurer, A. S. Kappella; librarian, H. E. White.

NEW ATLANTIC CABLE.—It is announced from Cologne, Germany, that the German Atlantic Cable Company has received a concession from the Spanish Government for a third cable from Emden to New York. It will use Teneriffe, Canary Islands, as an intermediate station.

SUBMARINE BOAT TESTS have been going on for some weeks at Newport, R. I., and interesting results have been noted as to submergence, endurance, distance runs, torpedo discharge, etc. A depth of 138 ft. has been attained and one of the tests last week was made with the object of showing how deep-sea cables could be cut by such craft.

GERMAN RAILROADS.—According to well-informed advices from Berlin, the Prussian Government intends in 1908 to begin the electrification of several of the state railroads of Western Germany, where the freight traffic is heavy. The Government's experts estimate that this will result in a considerable reduction in the cost of the operation of the roads.

SALE OF MUNICIPAL PLANT.—An election was held at Valley City, North Dakota, on May 6, when the question of selling the municipal electric light plant was carried by a vote of 168 against 61, showing the emphatic public opinion against continuance. Mr. H. F. Halverson, the city auditor, states that as soon as an inventory has been completed, the plant will be advertised and bids called for. The plant will be disposed of to the highest bidder, with a favorable franchise for its operation on a commercial basis.

ECONOMY IN LARGE TRANSFORMERS.—When the North Shore Electric Company, which operates around Chicago, took charge of the central-station property at La Grange, Ill., it overhauled the transformer system, and in place of 274 small old transformers substituted larger new transformers to the number of 57. Of course, many of the small transformers were running underloaded. Where it formerly took 48 to 50 amperes to supply current to the distribution system during light-load hours, it required only 14 amperes after the change was made.

AT STRATFORD-ON-AVON.—Stratford-on-Avon, England, has been provided with a public supply of electricity for lighting purposes. The corporation years ago obtained Parliamentary powers to supply the town with electricity, but, being owners of the gas works, failed to exercise their powers. Eventually public opinion and the Board of Trade compelled them to move, and they transferred their rights to a company, which has carried out the undertaking. The mayor, in a speech, denied that electric light would mar the ancient characteristics of Shakespeare's birthplace, and said it was useless to attempt to stem the tide of progress.

BOSTON OLD HOME WEEK.—Mr. John Campbell, of Boston, chairman of the New England section of the Illuminating Engineering Society, calls attention in circulars to the fact that the "Hub" is to have an "Old Home" week July 28 to August 3, and that the Society will hold its first annual convention there at that time. Mr. Campbell has been appointed by Mayor Fitzgerald chairman of the committee on electrical illumination, and it is proposed to have Boston do something considerable and creditable in that respect. This is fitting in view of the close historical relationship of Boston with all the developments in electricity.

ILLUMINATING ENGINEERING SOCIETY.—A regular meeting of the New York section of the Illuminating Engineering Society will be held at 8:15 p. m. at the Edison Auditorium, 44 West Twenty-Seventh Street, on Friday, June 14. A paper on "Industrial Plant Illumination" by Mr. George C. Keech will be presented. This paper will deal with illumination by mercury vapor lamps, "metallized" filament lamps and enclosed arc lamps. From measurements of illumination, conclusions will be drawn regarding the relative illuminating efficiency obtained with these three kinds of lighting in certain installations. All interested in the subject are invited to attend.

PRICE OF GAS.—The New York Legislature some time ago imposed arbitrarily a rate of 80 cents per 1000 cu. ft. for gas in New York City. The Consolidated Gas Company contested the legality of this, as unconstitutional, and the U. S. Circuit Court appointed Mr. A. H. Masten as a master in chancery to take evidence and report. The master has now filed a careful and voluminous report which is unfavorable to the city under every head and which finds fully for the company in its contention that it is justified in charging $1 per thousand as a reasonable price to secure a fair return on its plant and general investment and capitalization. There is also a technical discussion as to the impossibility of maintaining absolutely uniform candle-power and pressure over the whole system, as required now under a severe penalty for every violation.

JOHANNESBURG GAS-ENGINE PLANT.—According to reports printed in London newspapers the gas-engine electric generating plant at Johannesburg, Africa, is in a critical condition. It is stated that the gas engines can only be worked to three-fourths of their rated capacity, that the leakage of carbon monoxide from the gas producers is so serious that on one occasion 30 employees were rendered insensible, and that one of the gas engines was recently destroyed by the bursting of a cylinder. At present there are about 8000 kilowatts installed in six gas-engine units, and while for about six months the plant supplied adequate service, it is stated that recently only a dozen or fifteen out of the 60 electric cars can be run, and that it is impossible to supply satisfactory electric lighting. The plant represents an investment of about $1,000,000, and has not been accepted from the contractors.

POETIC ANTICIPATION.—It is a well known phenomenon that poets often anticipate inventions, but do not actually bring them into existence. With regard to the recent Brennan gyroscopic railway, still very much in embryo, it is noted that Mr. W. D. Howells, in his *Through the Eye of the Needle*—Chapter V. of Part Second—has the following descriptive of the railroads of Altruria: "There are swift little one-rail electric expresses running daily from one capital to another. The old steam-roads of the capitalistic epoch have been disused for generations, and their beds are now the country roads, which are everywhere kept in beautiful repair." Which shows that Mr. Howells, in addition to his other titles to fame, must now be given that of prophet, for his anticipation of such a striking and original invention. But an "interference" would not do him much good.

AMERICAN TRACTION NEWS FROM HUNGARY.—A notice in the *Pester Lloyd* of Budapest, Hungary, refers to a proposed electric trunk line between Budapest and Vienna, for which, it states, a franchise has been asked by Duke Paul Szapary and Engineer Emil Torok in connection with Bernard Nove, vice-president of the Detroit Construction Company. The traction system offered is the Leffler third-rail type, not unlike that used on the Milan-Varese line, but claimed to be a novel system which "the Detroit Construction Company has successfully used on its own large railway system" and which is said to be far more economical than any other method. It is also claimed that the electricity will be generated as cheap as by water power according to a new system, which, it is said, will be applied within the month to "a 200 kilometer American line of the Detroit Construction Company." The Duke and engineer mentioned have received the exclusive right from the Detroit Construction Company to use the new systems in Europe. It is further stated that they have also contracted to receive $25,000,000 from the International Railway Company for developments to be made. Viennese journals have printed similar statements, apparently from the same source.

Generating Stations and Sub-Stations of the Potomac Electric Power Company, of Washington, D. C.

TOWARDS the close of the year 1881, what was left of the Army of the Cumberland gathered in Washington to dedicate the statue of General Thomas, in Thomas Circle, at the junction of Massachusests and Vermont Avenues, a few squares northwest of the White House. In order to make the occasion memorable, various plans were formulated for the entertainment of visitors. Chief of these was the illumination of Pennsylvania Avenue from the Peace Monument to the Treasury Building with electric arc lamps, which until that time were unknown in Washington. The lamps were suspended over the center of the roadway from guy wires stretched from housetop to housetop, and a dynamo belted to an engine in a saw mill on Thirteenth Street supplied the electricity. At the appointed hour, the famous avenue was thronged with people anxiously awaiting night to be transformed into day by means of the arc lamps; but owing to the primitive apparatus and sputtering arcs, the display was rather indifferent.

The interest aroused, however, resulted in the formation of the Heisler Electric Light Company, which after a painful existence transferred its property and franchises over to the United States Electric Light Company of Washington, in November, 1882. New resources and energy were introduced by Philadelphia and New York capitalists and an entirely new electrical equipment was installed. At the first annual meeting in November, 1883, it was reported that 91 arcs and 100 incandescent lamps were in operation. Fire wiped out the plant in July, 1885, and the company leased the plant of the Brush Electric Light Company, then an aspiring competitor. In about two weeks, the principal circuits were again in operation. In 1884, the company laid, at great expense, an underground service on Pennsylvania Avenue, using a sealed-up conduit system; it was also among the first to adopt the terra cotta conduit system and to-day has many hundreds of miles of duct in successful operation. After the absorption of the Brush Company, rivalry was threatened by the Thomson-Houston Company of Boston, and arrangements were immediately made by the local corporation to control the arc-lamp patents of the Thomson-Houston Company in the District of Columbia.

Up to that time the central station equipment was located in leased buildings, and in the fall of 1886, a site was purchased for a new station and it was also decided to install the Edison system of central station lighting for incandescent lamps on a large scale. From this point on the development of the company was as rapid as could be expected, it requiring, for instance, a specific act of Congress to enable the company to extend its conduit system. In 1895 it was determined to erect alongside the old plant the finest central station possible to construct. The remodelling of the service was placed in the hands of Messrs. Sargent & Lundy, of Chicago, and the new station was erected at the corner of B and Fourteenth Streets.

FIG. 1.—DYNAMO ROOM; B AND FOURTEENTH STREET POWER HOUSE.

The present station on that site has been considerably enlarged since then, although some of the original equipment is still in service. The plant was new in 1897, and at the time was considered large enough to meet the demands of a city like Washington for ten years to come.

The old station was arranged somewhat in the form of a hollow square and contained 16 boilers of various makes ranging in size from 80 hp to 375 hp; 21 engines, ranging in size from 15 hp to 500 hp, and 34 generators, from a 50-light arc machine to a 175-kw Edison bipolar machine. Here certainly was diversity enough to tickle the fancy of the average electric light man of that time. The new station as then designed was 131 feet long by 123 feet wide. The boiler equipment consisted of six B. & W. water-tube boilers, each of which had a nominal hp of 375 and a maximum of 525 hp. The working steam pressure was 160 lbs., and the stoking was effected by link belt grates of B. & W. design. Coal was brought from Georgia Creek mines and discharged from carts

into chutes leading direct to a motor-driven crusher. From the crusher the coal was conveyed by an automatic bucket conveyor to bins and hoppers over the boilers where storage capacity for 1200 tons was provided. Feed water was at that time bought from the city through meter at a rate of three cents per 1000 gallons. A Green economizer was also installed

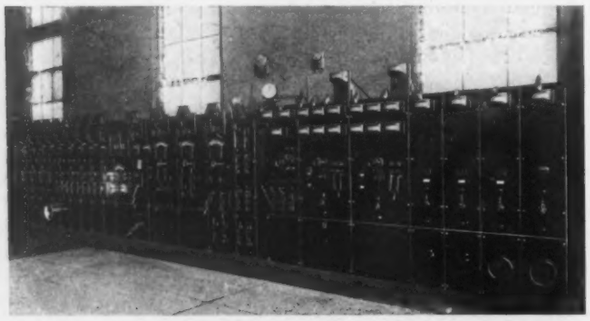


FIG. 2.—EAST END SWITCHBOARD; B AND FOURTEENTH STREET POWER HOUSE.

above the boilers, and the ashes from the grates of the boilers were removed without rehandling by the conveyor to an ash bunker conveniently located for discharging into carts.

In the engine room at that time were two 1200-hp and two 700-hp McIntosh & Seymour horizontal, tandem-compound, condensing engines. The condensers were located underneath the outboard bearing and all four engines had direct-connected air pumps operated from the ends of the shafts by means of cranks. Each of the 1200-hp engines drove in addition to a pair of 250-kw direct-connected generators, a portion of a line shaft in the basement. This shaft, which was 100 feet long, was equipped with friction pulleys and clutches for dividing it. The clutches were controlled by quadrant rack and pinion in combination with hand wheels mounted on stands on the floor

FIG. 3.—BOILER ROOM; B AND FOURTEENTH STREET POWER HOUSE.

above. The shaft had belted to it eight Brush arc machines. Each of the smaller generator units was direct-connected to a pair of 250-kw machines, constituting a complete Edison three-wire generating unit. Sewage water was used at that time for condensing purposes.

A set of three-wire boosters was included in the equipment of the new station for boosting the incandescent feeders on long runs and for operation in connection with a 150-cell storage battery. The switchboard was 72 feet long and was divided in three sections—arc, alternating incandescent and direct-current incandescent. The alternating current portion of the board displaced the board in the old station and served to distribute the circuits from the alternators in the old plant. The Edison system of three-wire feeding was used exclusively up to distances of 6000 feet.

In 1898, the company supplied the equivalent of 75,000 incandescent lamps of 16 candle-power; 700 arc lamps, and 1200 horse-power in motors. The charge for energy for lamps was 15 cents per kw-hour with a 10 per cent discount for prompt payment, and the electricity for motors was supplied at the rate of 13½ cents per kw-hour with discounts as high as 40 per cent, depending on the amount of energy used. Arc lamps were supplied to the District of Columbia and to the National Government at the rate of 25 cents per night, and furnished to all other users at the rate of 40 cents per night.

In the summer of 1901, the company built an extension to its plant; the addition being built on the site formerly occupied by the first power house of the company immediately adjoining the new plant described above. Like this building, the extension was of brick and iron and was fireproof. As far as possible the addition was a duplicate of the new plant in size. The arrangement of the boilers, engines, generators, etc., conformed very closely to the equipment already installed. There was, of course, a great difference in the electrical units, the newer units being with few exceptions intended for street railway service.

The east wall of the power house was removed and the tracks of the electric traveling crane extended, so that the same crane served for the handling of machinery in the addition, as well as that in the older part of the building. Six new B. & W. boilers were set in pairs and placed alongside of the other boiler equipment, and space was provided for a seventh boiler at the end of the row. The coal-handling machinery was extended to suit the new conditions, and a flue was built connecting the new boilers with a short stack, a blower for induced draft being placed between the economizer and the short stack. The hot gases from the new boilers were passed through the economizer. The blower for supplying the draft was engine driven and was 13 ft. in diameter. Owing

FIG. 4.—SWITCHBOARD; B AND FOURTEENTH STREET POWER HOUSE.

to the great trouble occasioned by trash in the sewage water, the use of sewage water for condensing purposes was discontinued and water was taken directly from the Potomac River.

At considerable expense, the company built a concrete tunnel 3 ft. wide by 4 ft. high with an inverted U-shaped section. The bottom of the tunnel is 6 ft. below the surface of the river at low tide and about 20 ft. below the surface of the ground between the river and the power house. The lower half of the trench in which the tunnel is built is lined with sheet piling, and the bottom of the trench is covered with concrete one foot thick, concrete of the same thickness being filled around the forms. From the intake on the Potomac, near the Washington

Monument, to the well or reservoir on the company's property is nearly 2800 feet. The average grade of the tunnel from the river to the power house is small; but there is a very decided drop of 6 feet at the well. Nearly the entire distance of the tunnel is within the Washington Monument grounds, and nearly all of that distance is made land. The water from the condensers empties into the city sewer.

In making these changes, the controlling company was enabled to close up two street railway power plants and to further centralize its power equipment. The engines and generators trolled by the Washington Railway & Electric Company. The company now has two main electric generating stations; one at B and Fourteenth Streets and the other just completed at Bennings. The company also owns the rights and property of the Great Falls Power Company, which concern was formed to develop the water power going to waste at the falls on the Potomac a few miles above the city. As yet nothing has been done in the way of utilizing this water power, and to all appearances nothing will be done for some time to come.

The present equipment in the B and Fourteenth Street

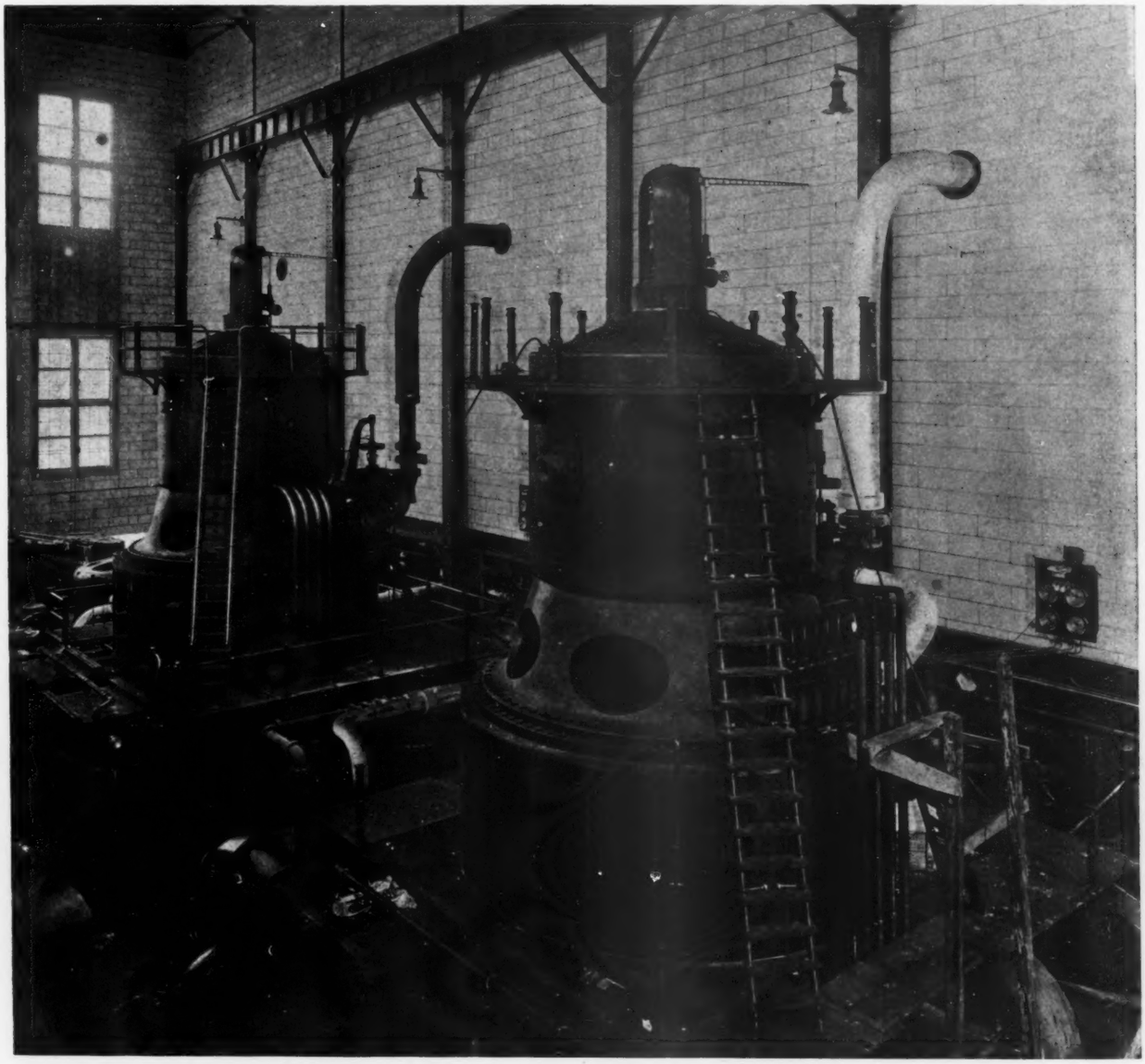


FIG. 5.—5000-KW TURBO-ALTERNATORS IN BENNINGS POWER HOUSE.

from the P Street power house and from the Columbia railway power house were transferred to the new building. This made the equipment in the power house as follows: One new 600-kw, 300-volt generator; three 500-kw, 500-volt generators, and one 800-kw, 500-volt generator in addition to the equipment already installed in the older portion of the plant.

Since 1901 the growth has been very rapid, until now the Potomac Electric Power Company, which absorbed the United States Electric Light Company and is itself controlled by the Washington Railway & Electric Company, supplies all of the electricity used for lighting in the city of Washington and all the energy necessary for the operation of the railways con-

station is as follows: In the boiler room there are six 300-hp and fifteen 450-hp B. & W. water-tube boilers. Thirteen of these are fitted with Hawley down-draft furnaces and eight with Roney stokers. Six of the boilers are fitted with B. & W. superheaters, which superheat the steam 150 degrees above the temperature of saturated steam. The working steam pressure is 180 pounds. The fuel used is George's Creek semi-bituminous coal giving good combustion with practically no smoke coming from the stacks under ordinary circumstances. The coal is dumped into the hoppers on either side of the station whence it is taken by a conveyor having a total length of about 600 feet to the bins overhead, where a storage capacity for

1600 tons of coal is provided. The furnaces are fed with coal delivered through chutes so that there is no shoveling of coal into the hoppers, the firemen merely keeping the fuel leveled. The ashes are removed by the same conveyor and dumped from a receiving bin into carts through chutes in the side of the building. A peculiarity in the coal situation is that notwithstanding that the coal comes by rail in winter and by canal in summer, there is no difference in the price, which is $3.20 per ton delivered, the coal company carting the fuel to the station.

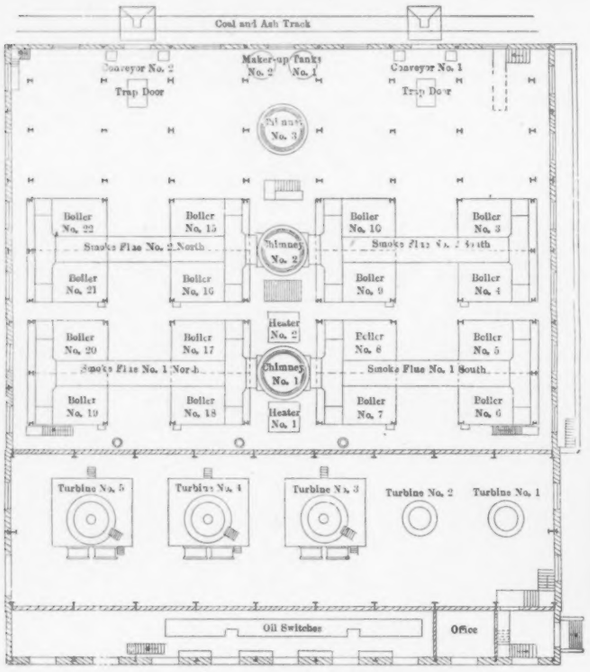


FIG. 6.—GENERAL PLAN OF BENNINGS POWER HOUSE.

Feed-water is taken from the Potomac River through the tunnel already described, the feed-water being filtered through pressure filters before passing through the feed-water heaters. Three of these filters are capable of filtering 15,000 gallons of water per hour. All the pumps are steam driven. Besides two open feed-water heaters there is an 1800-hp economizer through which the feed-water is pumped.

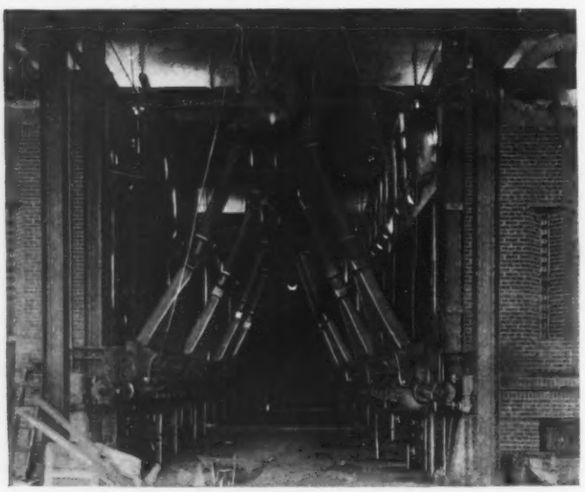


FIG. 7.—PORTION OF BOILER ROOM, BENNINGS STATION.

In the engine room are eight McIntosh & Seymour engines; five of which operate lighting units and three operate railway units. Taken in order there is a 1200-hp engine direct-connected to two 240-kw, 110-volt generators; this engine also drives a line shaft in the basement to which are belted eleven Brush arc machines and two 300-kw, 2300-volt alternators. All of the electrical machinery is on the engine room floor. Each of the next two units has a rating of 700 hp and is direct-connected to two 240-kw, 110-volt generators. The fourth engine is direct-connected to two 480-kw, 110-volt generators, and the fifth engine is direct-connected to a 600-kw, 300-volt generator.

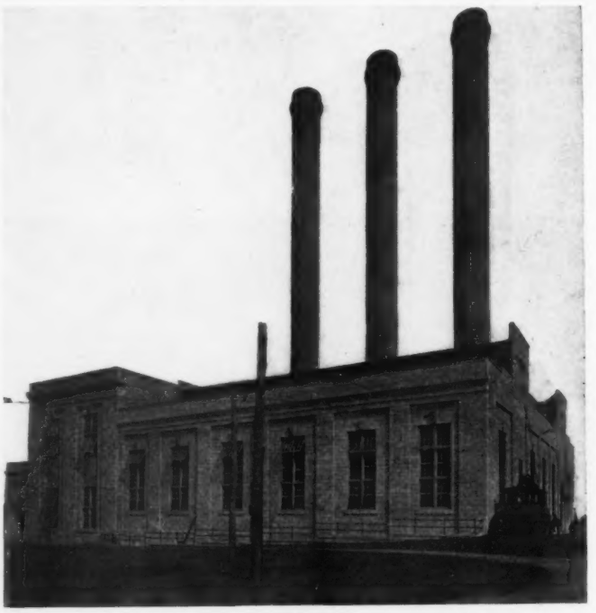


FIG. 8.—BENNINGS STATION, SHOWING ELECTRIC LOCOMOTIVE.

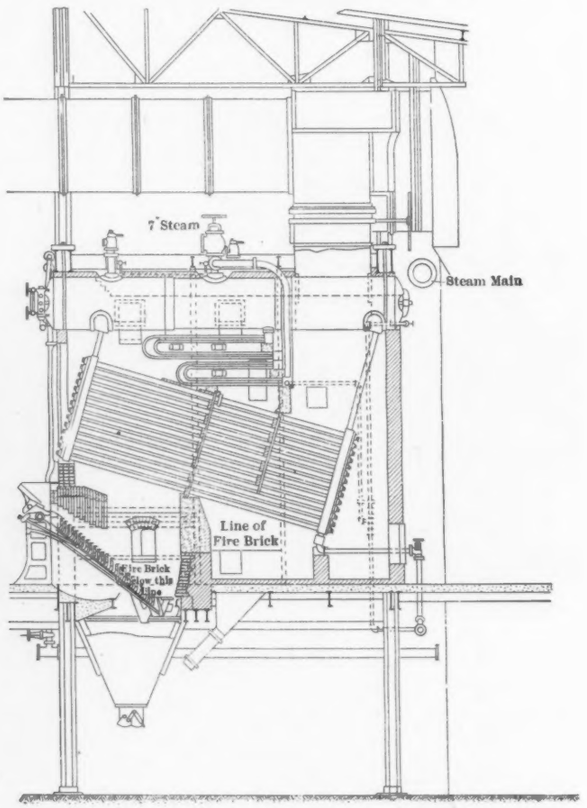


FIG. 9.—DETAILS OF BOILER SETTINGS.

The remaining engines drive two 500-kw, and one 800-kw, 500-volt railway generators. The first four engines were the ones installed when the station was first built, and as was noted before the condenser pumps are crank-connected to the

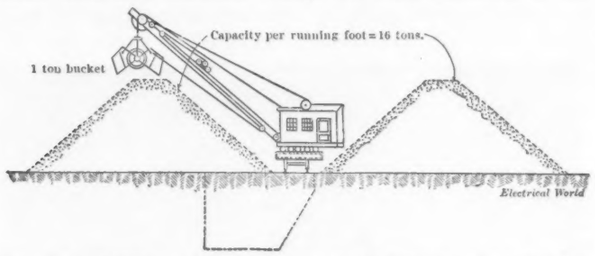


FIG. 10.—PROPOSED COAL STORAGE ARRANGEMENT AT BENNINGS STATION.

end of the shaft and run at the same speed as the engines. The other five units have jet condensers supplied by independently-driven Worthington duplex pumps. Besides the above equipment, there are installed two frequency changers; one of 500-kw and the other of 1000-kw capacity, which change the frequency from 25 to 60 cycles and the voltage from 6600 to 2300 volts. Current at the latter potential is used for all lighting circuits outside the limits of the Edison three-wire system. There is also installed a 500-kw, 250-volt rotary converter set, feeding directly into the three-wire system. The photograph showing a general view of the engine room of this station also shows a Curtis steam turbine unit in the background. This will be dismantled and form part of the equipment at the Bennings station described later.

The distribution system from the station is all underground. The station feeds into the network of the Edison three-wire system with twenty-three feeders and also has ten feeders for 2300-volt, 60-cycle, single-phase circuits, not to mention the railway circuits. The alternating current is three-phase at the switchboard; but is distributed as single-phase.

BENNINGS TURBINE STATION.

The new station, which is now the main generating plant of the Potomac Electric Power Company, is located at Bennings, on the eastern branch of the Anacostia River, and all the work in it was carried out under the direct supervision of Mr. L. E. Sinclair, general superintendent of the Potomac Electric Power Company; the engineers and contractors being Messrs. J. G. White & Company, of New York.

The layout of the building is similar to many of the modern prominent turbine generator stations. The boiler room is arranged at right angles to the generating room, while the switching apparatus is located in an annex, running along the entire length of the generating room. The boiler room, which is 164 ft. long by 180 ft. wide, is arranged so as to accommodate four rows of boilers, thus forming two firing aisles. There are at present installed sixteen boilers, while space is provided for eight additional. There are three stacks (one for every eight boilers) and two suspended steel coal bunkers with a capacity

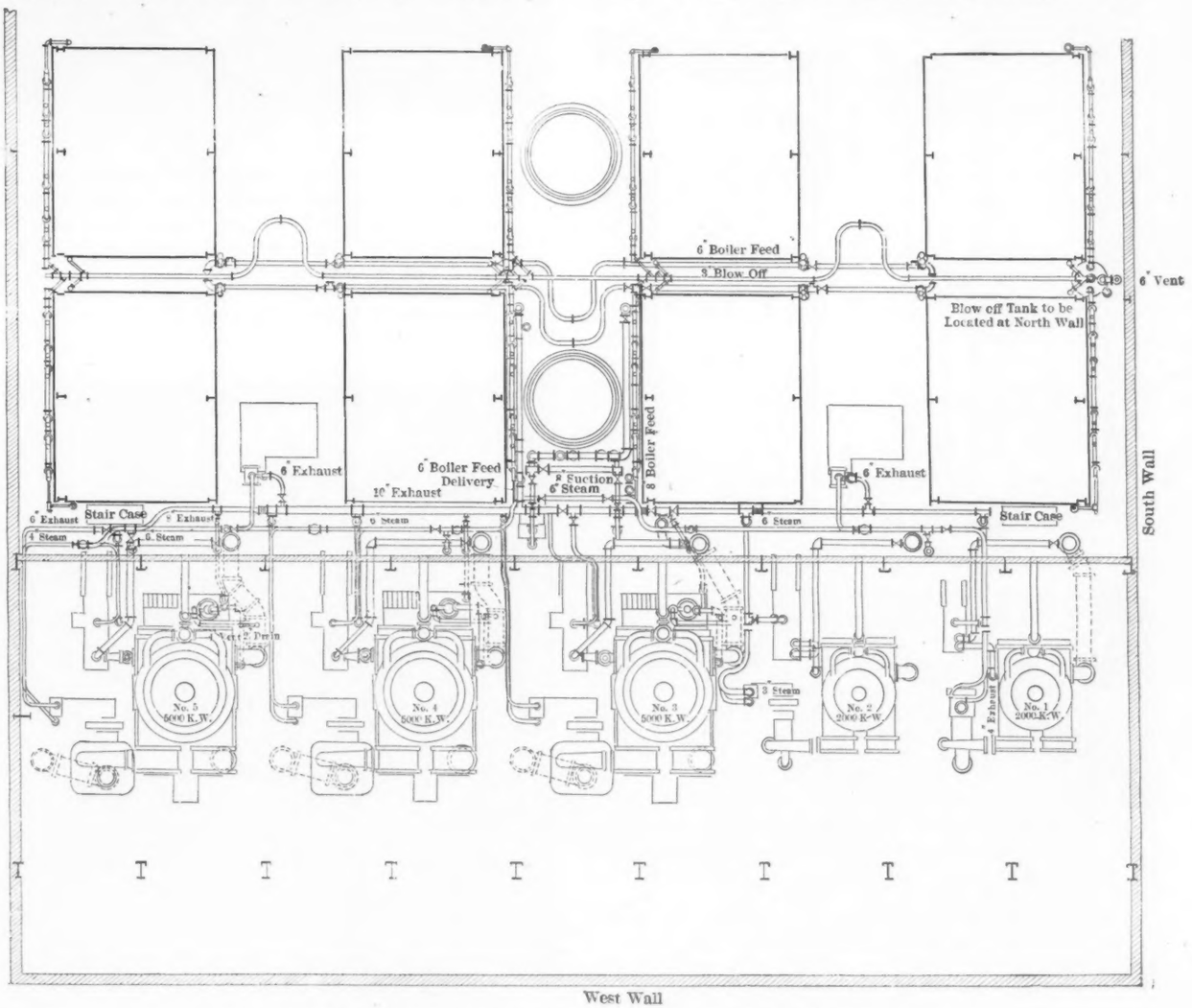


FIG. 11.—GENERAL ARRANGEMENT OF PIPING, BENNINGS POWER HOUSE.

of 650 tons each. The boiler house is provided with a basement 14 ft. high; the floor of which is flush with the main generating room floor. It contains, besides the coal and ash-handling plant, a repair shop, store-room and a locker and toilet room. Of more importance, however, is the machinery in the boiler room basement. Here are installed two exciter units, the boiler feed-water pumps, oil pumps and two house pumps, as well as the oil filtering tanks and testing tanks. The space occupied by this machinery is separated from the rest of the basement by a hollow concrete block wall, thus forming an extension of the main generating room floor. This is possible owing to the fact that the division wall between the generating room and the boiler room does not start from the main operating room floor, but starts some 14 ft. above it and is carried on I-beams.

The generating room, which is 164 ft. long by 45 ft. wide, has been laid out to accommodate three 5000-kw and two 2000-kw turbines. At present there are, however, only two 5000

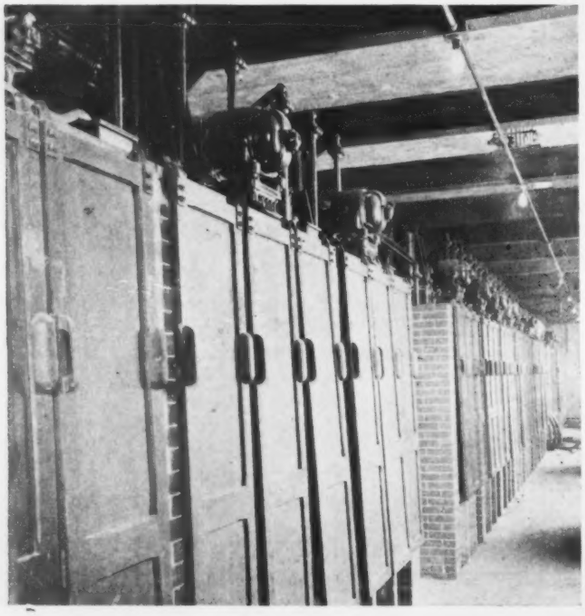


FIG. 12.—OIL SWITCHES, BENNINGS POWER HOUSE.

and two 2000-kw turbines to be installed. The annex for the switching compartments, offices, etc., is 15 ft. wide by 164 ft. long.

Owing to the condition of the soil, it was found necessary to drive piles for the greater part of the footings for the engine room wall columns, etc. These piles are made on what is known as the Raymond concrete system and are from 30 ft. to 40 ft. in length. The turbine foundations, owing to their depth, did not require any piling. This was due to the peculiar arrangement of the condensing water intake and condensing water discharge tunnels running directly through the turbine foundations. This arrangement materially reduced the amount of concrete necessary for the foundations, and, at the same time, gave a most satisfactory arrangement for obtaining the circulating water. Both the intake and discharge tunnels have an area of 40 sq. ft. each.

The footing of the turbine foundations was calculated for a bearing power at 1.8 tons per sq. ft. of soil. In order to prevent uneven settlement, between the different turbines, old rails are embedded in the concrete of the tunnel, throughout the length of the building. As the entire building covers an area of 29,520 sq. ft., and as the normal output of the plant is 19,000 kw, 1.52 sq. ft. is taken up per kw. The structural steel required for the building amounts to about 800 tons.

Up to the basement floor, all wall and column footings are made of concrete, while the superstructure consists of a self-supporting steel skeleton frame. The walls are of hollow concrete blocks, self-supporting, with the exception of a few of the lighter walls. These hollow concrete blocks were made by the Lake Stone Company, of Washington, D. C., and are of a uniform size, being 3 x 1 x 1 ft. However, there are some specially designed blocks, such as were required by the door

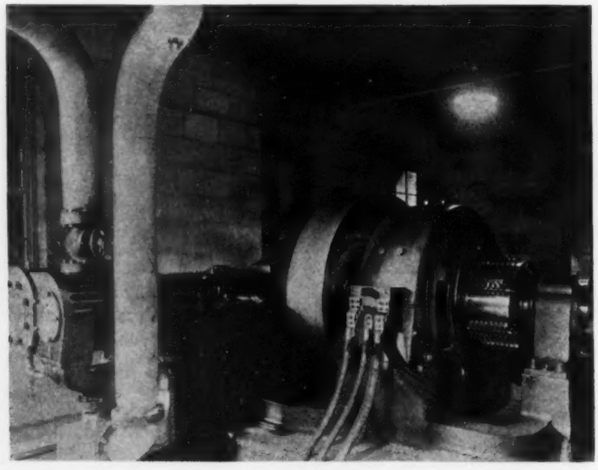


FIG. 13.—EXCITER UNIT, BENNINGS STATION.

and window lintels and sills. Some of the lintels have a span of 12 ft. and are reinforced by ¾-in. rods. In fact, all lintels are reinforced. The pilasters and cornices of the building are well designed and the architectural features of the entire structure give a pleasing appearance and harmonize with the tall chimneys, also made of concrete.

Coal is brought to the plant on railroad cars and is stored in the yard or dumped into pockets at the side of the boiler rooms,

FIG. 14.—SWITCHBOARD, BENNINGS POWER HOUSE.

crushed and then delivered to the top of the bunkers in the boiler room, by means of bucket conveyors. From here the coal is distributed into bunkers by means of two belt conveyors having a capacity of 40 tons per hour each. In the yard, storage capacity for over 100,000 tons of coal is provided. An

electric traveling crane of the type shown by Fig. 10 will be used to handle the coal as it is dumped from the railroad cars and arrange it into piles of suitable size. A double trolley electric locomotive is used to haul the cars from the railroad siding to the station and will also be used in drawing coal from the piles to the station. Ashes may be removed, either by railroad

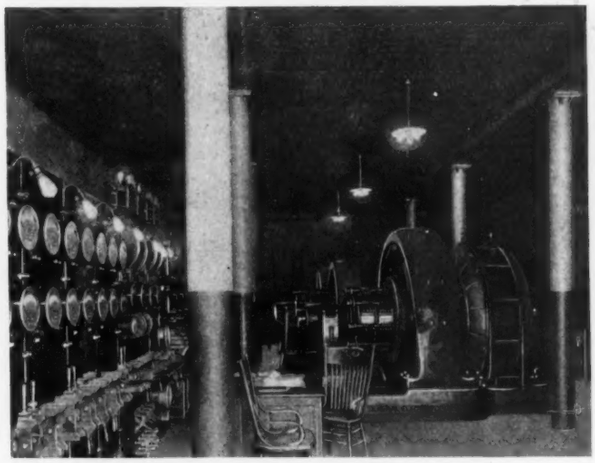


FIG. 15.—INTERIOR OF SUB-STATION NO. 1.

cars or by teams. The ashes are collected in reinforced concrete hoppers suspended under the boilers from where they are removed on an industrial railway system and dumped into a receiving hopper feeding the above mentioned bucket conveyors, in order to store same in ash hoppers arranged between the coal bunkers and the end wall of the boiler room. These hoppers have a storage capacity of approximately 50 cu. yds. each.

capable of superheating the steam 150° Fahrenheit. The boilers are provided with Roney stokers, each having a grate area of 111.8 sq. ft. The fronts of the boilers are faced with white enamel brick.

The flue connections are made on the top of the boilers; four boilers joining in one breeching, thus giving two breechings for each chimney. Each boiler is provided with a hand damper, while the four main flues are equipped with dampers operated by two automatic regulators.

The three chimneys are of the Weber concrete steel type, and are 200 ft. in height above the basement floor; 183 ft. in height above the grates; 163 ft. in height above the flue openings, and have an internal diameter of 12 ft. One of the stacks is kept in reserve for the additional eight boilers which are to be subsequently installed.

Between the boilers and the chimneys there are installed two Warren-Webster open feed-water heaters, each being capable of heating 200,000 lbs. of boiler feed-water from 80° to 205° Fahrenheit per hour. In order to make up the loss, caused by leakage, etc., two make-up tanks have been installed in the boiler room, each having a storage capacity of 25,000 lbs. of water. For this purpose there are installed two house pumps.

The boiler feed-water is supplied by two horizontal duplex pumps, 16 ins. by 10¼ ins. by 16 ins. An additional pump will be installed with the full equipment of the plant. These pumps work upon a 6-in. header ring system from where the branches lead to the boilers. The arrangement is such that either pump may supply water to any of the boilers. Branch connections to the boilers are so centrally located that the water tender may operate the valves of eight boilers from practically one point. All steam leads from the boilers are 7 ins. in diameter and are connected to the main header system by means of flexible bends, as will be seen in the accompanying illustration. The largest size of this header is 15 ins. outside diameter. Pipes are all made of steel with the exception of fittings, which are

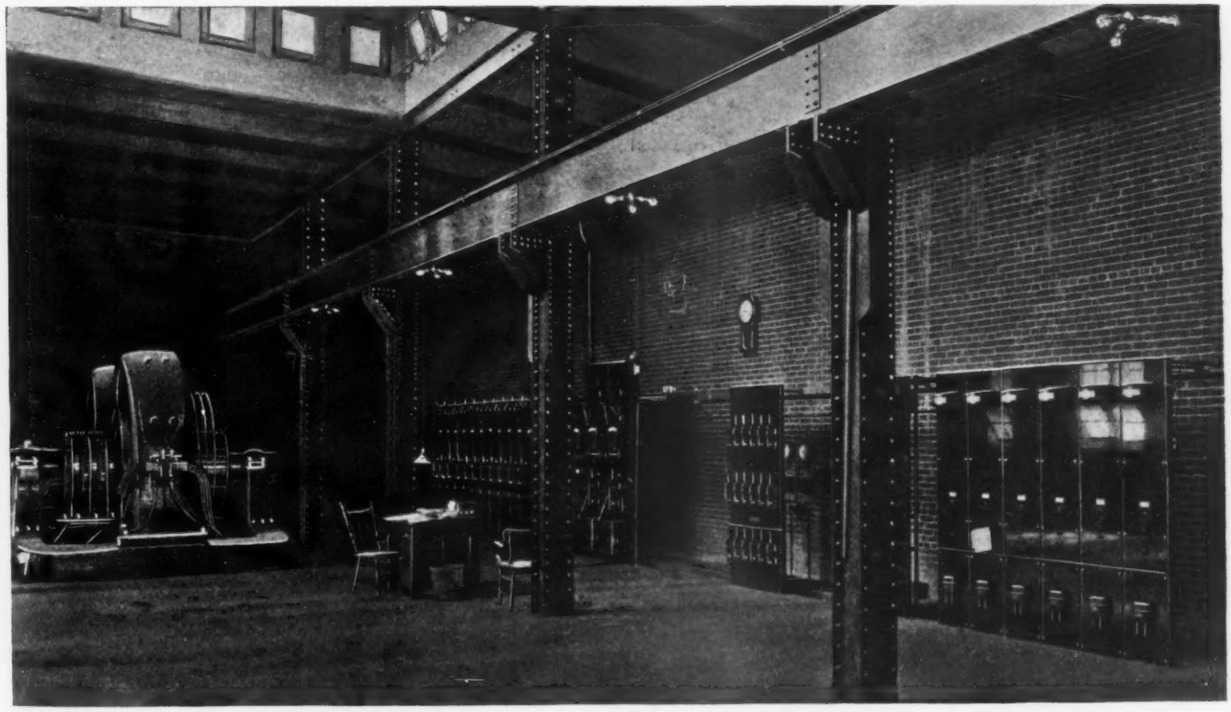


FIG. 16.—GENERAL VIEW OF SUB-STATION NO. 2.

As stated previously, there are installed sixteen boilers, arranged in four rows, two boilers forming one battery. All boilers are of the Babcock & Wilcox make, having a heating surface of 6040 sq. ft., designed for 175 lbs. working pressure and equipped with superheaters of 1180 sq. ft. heating surface, of semi-steel. All pipes have been provided with the loose type flange, known as the Van Stone flange. From the header the branches lead to the turbines, the size of which are as follows: 10-in. pipe to the 2000-kw turbines, and 12-in. pipe to the 5000-kw turbines.

These sizes of pipes have been chosen by the designing engineers, because of the use of superheated steam. As the turbines operate with 17 lbs. of steam per kw-hour, and as the volume of steam superheated 160° Fahrenheit is practically 30 per cent greater than that of saturated steam at same pressure (175 lbs.), the velocity of the steam in the pipes will be approximately 7800 ft. per minute.

No separators have been installed in the pipe line, but provision is made to drain the entire system, for which purpose four 1¼-in. traps have been located in the basement of the boiler room. The return water is fed into the feed-water heater. A separate 6-in. steam header has been installed in the basement for the auxiliary machinery. This header runs the entire length of the plant and draws its steam at three points from the main header, by means of 6-in. connections. This auxiliary header is also provided with a drip system of two ¾-in. traps. All steam piping, both main and auxiliary, is covered with 85 per cent magnesia.

The turbines are of the Curtis base-condenser type; the two 2000-kw units being four stage and the 5000 units five stage. The alternators are four-pole, 25-cycle, three-phase machines designed for 6600 volts. The turbines run at 750 r. p. m.

The first turbine installed was one of 5000-kw unit, which has been in operation since the early part of December. The cooling surface of the condensers of these 5000-kw turbines is 20,000 sq. ft. The circulating water is drawn by means of a

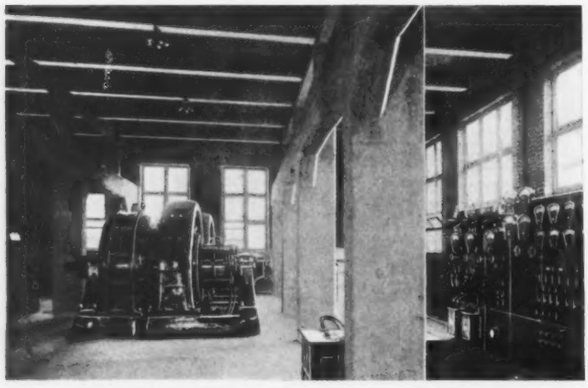


FIG. 17.—INTERIOR OF SUB-STATION NO. 10.

24-in. steam-driven, centrifugal pump. The vacuum pumps are of the rotative single-stage type, also steam driven. The hot well pumps which are located in the hot well pits, 5 ft. 9 in. below the main operating room floor, are vertical two-stage, centrifugal pumps and are the only pumps motor driven. The auxiliary machinery is grouped around one main turbo-generator so as to form a compact unit system. The other 5000-kw unit is arranged in the same manner.

The 2000-kw turbines, which will be installed, are not new and have been in operation in the company's other power plant. One of these units was exhibited by the General Electric Company, at the World's Fair, St. Louis. It is provided with a base-condenser, while the other unit has a separate condenser, but will, however, be re-designed for a base-condenser, in order to have the entire plant equipment uniform. The auxiliary machinery of these turbines, such as the circulating water pumps, hot well pumps, etc., is now being taken out of the B Street station. One of the dry vacuum pumps will be replaced by a new one.

The atmospheric exhaust pipe leads to a tunnel under the generating room floor into the boiler house where the riser extends through the roof. These exhaust pipes, which are 24 in. in diameter on the 5000-kw units, are provided with a relief valve. The hot well pumps discharge into a common header, which leads to the two heaters. The discharge from the hot well pump is provided with a gate valve and a check valve, in order that should one pump fail to work the water of the other pump may not enter the pump not in operation. The suction of the vacuum pump is provided with an angle globe valve so that in case of emergency the turbine may operate on an atmospheric exhaust line, while this pump is being repaired. The discharge of the dry air pump is connected to the exhaust risers above the relief valve. The exhaust of all auxiliary ma-

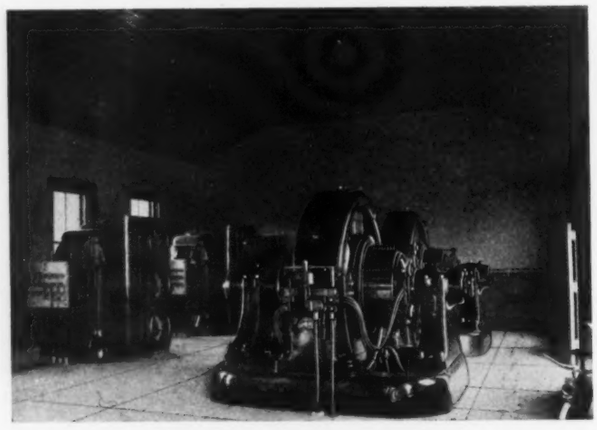


FIG. 18.—INTERIOR OF SUB-STATION NO. 11.

chinery discharges into one common header, which leads to the open feed-water heaters.

There are at present installed three step-bearing pumps to supply oil to the various turbines; arrangement is made for another pump of this kind. The return oil is brought back to a collecting tank, from where it is drawn by an auxiliary oil pump into oil filtrating storage tanks, each having a capacity of 1600 gallons. One filtering tank and one auxiliary pump are at present installed.

There are installed two 100-kw, 125-volt, engine-driven exciters, which are of sufficient capacity to supply the necessary excitation current for the entire plant. These exciter units are located, as previously stated, in the basement of the boiler room.

The switching room annex is three stories high. The first floor is flush with the generating room floor and contains the manholes for the generator leads and the outgoing cables, which are arranged in double tile ducts, on the side of the wall, whence they lead underground to the various sub-stations. Here are also installed the generator field rheostats, while at one end is located a toilet room. Above this floor is a gallery

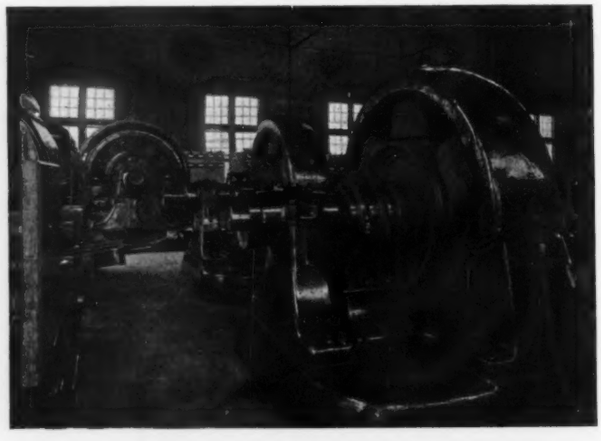


FIG. 19.—INTERIOR OF SUB-STATION NO. 12.

containing the oil switches. The oil switches control the generators and the outgoing feeders, together with two bus-sectionalizing switches. These switches are of the cellular type, each pole being mounted in a separate concrete compartment, arranged in one row. Directly back of these cells are located the bus-bar compartments. The static discharge and disconnecting

switches are located in brick compartments between the bus-bar compartments and the wall. The second gallery, which is located above the former, contains the switchboards. The generator switchboard is made up of five panels (one for future use), while the exciter switchboard is made up of two panels. The feeder switchboard is made up of nine panels; three of these panels being for future equipment. The switchboards are made of black enameled slate of dull finish, supported by a pipe frame work and containing all controlling switches, indicating lamps, instruments, etc. The entire switching compartments are separated from the main generating room by a division wall, which is provided at the upper switchboard gallery with large openings in order to overlook the generating room.

SUB-STATIONS.

In addition to the main station just described, the Potomac Electric Power Company has erected four new sub-stations to take care of the increasing low-tension lighting, railway and 2400-volt lighting loads. These sub-stations are known as No. 2, No. 10, No. 11 and No. 12.

Sub-station No. 2 is located at 450 Washington Street, N. W., adjoining the old sub-station No. 2. It is 100 ft. in length by 14 ft. 8 in. in width and one story in height. The building is of steel, brick and reinforced concrete for roof and floors. This station is designed for 6000 kw capacity and there is installed at the present time two 1000-kw rotary converters with two 1100-kw, three-phase transformers. These transformers are

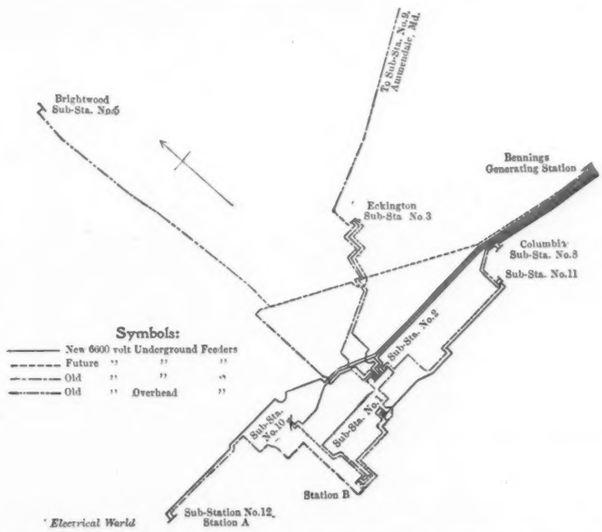


FIG. 20.—MAP SHOWING HIGH-TENSION FEEDERS INTERCONNECTING STATIONS.

equipped with dial switches so that the voltage on the direct-current side of the rotary transformers can be varied. This station, which is to be the principal sub-station, is equipped with a number of type H-3 automatic remote control oil switches. The current is brought to this station from the main power station and is distributed to other small sub-stations through the above-mentioned switches. There is one type H switch controlling the apparatus in the sub-station, while the oil switches that control each rotary separately are of the K-4 type and are non-automatic, it being the intention in case of any trouble inside of the station, to have the "H" type switch to protect the sub-station as well as prevent any of the other lines being disturbed due to the trouble.

This station is also equipped with a large three-wire lighting switchboard which is connected to a storage battery located in the adjoining building. This battery can be used either on the railway or lighting busses.

Next in order is Sub-station No. 10, located in the alley between H and I, Fourteenth and Fifteenth Streets, N. W. It is 86 ft. long and 45 ft. wide and two stories in height. This building, with the exception of the walls, which are of brick, is made of concrete. A 10-ton travelling crane on concrete girders is provided for the handling of apparatus. This station is designed for 5000-kw lighting capacity to feed the Edison three-wire system and is equipped with two 500-kw induction motor-generator sets and also a balancer set having a capacity of 75 kw. The foundations are laid out so that either rotary converters or motor-generators can be installed.

The second story is laid out for a storage battery of 250 cells and special attention has been given to the floor of the battery room to insure its being practically acid proof. The floor is designed to drain both ways so that it can be washed down at any time. It is built of acid-proof brick laid in boiling pitch with ⅜-in. joints which were afterwards filled with hot pitch. The room is well ventilated and lighted and has practically no metal to be attacked by fumes. It is separated from the end cell switch rooms and other rooms by cement partitions. The controlling apparatus is of the same type as used at Sub-station No. 2 except that there are motor-generator sets here which are started through compensators.

Sub-station No. 11 is located at Thirteenth and D Streets, N. E. This building, which was remodeled from an old office building, is 80 ft. long and 30 ft. wide and one story in height. The sub-station is designed for three 500-kw rotaries to be used entirely on railway work and feeds into the ends of four roads whose extreme easterly lines are in the vicinity of this sub-station. This apparatus is controlled by type H-3 automatic, remote control oil switches. The rotaries are started up from the alternating-current side through taps brought out from the transformer for that purpose.

Sub-station No. 12 is located in the old steam-power station at Thirty-Third and K Streets, N. W. The apparatus is located in one corner of the building where there is being installed two 500-kw rotaries for railway work and one 500-kw frequency changer set to supply 60-cycle, 2400-volt current for lighting in that territory. The equipment is such that in case anything happens to this sub-station the steam-driven machinery can be gotten under way at very short notice; the men retained being familiar with the operation of steam engines.

Besides equipping the above sub-stations with the apparatus mentioned there has been placed in service in the Fourteenth and B Streets plant one 1000-kw frequency changer set for the purpose of supplying the 60-cycle, 2400-volt commercial lighting circuits as previously mentioned.

Besides the above-mentioned sub-stations, the only other sub-station used to supply 110 and 220-volt lighting service is Sub-station No. 1, located on Eighth Street near D Street. The equipment of this sub-station comprises two 500-kw, 25-cycle rotaries with transformers and blowers; a 500-kw motor-generator set and a storage battery of 150 cells, together with the necessary switchboards for controlling the various circuits. Sub-stations Nos. 3, 4, 5, 6, 7, 8 and 9 supply street railway circuits and two new sub-stations to be known as Sub-stations Nos. 13 and 14 are now being built. Sub-station No. 13 is located at Bennings, and will supply the Columbia line of the Washington Railway & Lighting Company and the Washington, Baltimore & Annapolis lines. The voltage for the latter lines will be stepped up to 33,000 and distributed to Academy Junction, where it will be used on the new 6600-volt single-phase trolley road now being built. Sub-station No. 14 will also feed railway circuits. Fig. 20 is a diagram of the distribution circuits connecting the various sub-stations and generating stations. The wires are all underground, for, compared with other cities, Washington may be fairly termed "wireless."

BUSINESS-GETTING METHODS.

The company employs 11 solicitors on a straight salary basis and carries advertisements in the daily newspapers and also on billboards. In addition, the company publishes the *Pepco News*, which is regularly mailed to 5000 people. This monthly bulletin is well printed and illustrated and five numbers have already appeared, the first number having been published last January. The company uses a system devised by one of the advertising companies making a specialty of central station work.

Although ordinances in force in Washington do not permit

electric signs to extend over 3½ ft. beyond the building line, the sign business is very flourishing albeit not so showy, save where the signs are on house tops, owing to this restriction. The income from signs last year approximated $30,000. The signs are put out on a flat basis, the revenue per 4-cp lamp per month on small signs averaging 40 cents. The rate on larger signs is based on the amount invested for two years with 6 per cent interest and with energy at the company's wholesale rate.

The company supplies all the theaters in the city and has now under way an energetic campaign for hotel business during the summer months. All the large hotels are equipped with isolated plants for the reason that the exhaust steam can be used in winter for heating the hotel and can also be utilized for a number of other purposes. In summer the amount of steam required is very small and some of the largest hotels have found it cheaper to use the electric light company's service during the summer months, than to generate their own electricity. The Potomac Electric Power Company makes a low rate for this service, seeing that it does not entail any extra investment and comes at a season most acceptable to the company.

The company also supplies all the garages with electrical energy at wholesale rates. As noted elsewhere in this issue, the number of electrical vehicles in Washington is very large for a city of its size, and the income derived by the Potomac Electric Power Company for this service alone is approximately $70,000 per year; or more than double the income from electric signs.

The connected motor load approximates 7000 horse-power, mostly in direct-current motors; there being a small number of alternating-current motors scattered over the system. As a basis for comparison, it may be of interest to note the connected loads and the total kw-hours of energy generated during 1906 and 1901. At the end of 1906, the direct-current load in equivalent 16-cp lamps was 299,798, while the alternating-current load was 116,896. The horse-power of direct-current motors connected to the service was 6126 and of alternating-current motors 480. The number of kw-hours generated in 1906 was 46,490,729; 22,520,484 for lighting and 23,970,245 for railway circuits. In 1901, the total kw-hours generated was 30,691,756; 10,727,364 being for lighting circuits and 19,964,392 being for railway circuits. From this it will be seen that in five years the load on the lighting circuits has been more than doubled. The peak lighting load on the three-wire system in 1901 was 25,100 kilowatts and in 1906 it was 40,600 kilowatts. The connected load in 1901 in equivalent 16-cp lamps was 131,864 on the direct-current circuits and 42,158 on alternating-current circuits.

PUBLIC LIGHTING.

The Electrical Department of the District of Columbia has charge of the lighting of the District. All work in connection with the electric lighting of the public streets is done by the Potomac Electric Power Company operating under annual contract. The department inspectors give careful attention to the character of the service furnished and bring all matters of delinquent service to the notice of the electric light company. All changes and extensions are ordered through this department. Over 1000 arc lamps and as many incandescent lamps are in use, there being also a large number of gas and naphtha lamps used for public lighting. The 25-cp incandescent lamps are used principally in the suburban section of the District. The arc lamps with few exceptions are fed from underground mains. Those in the Edison three-wire territory are of the low-tension enclosed type, operated in multiple from the three-wire system. The other arc lamps are of the series enclosed type.

Because of the foliage, the lamps are suspended some distance from the curb line and at a distance from the pavement less than would ordinarily be the case. The lamps are also spaced closer than ordinarily. All the principal business streets are lighted with arc lamps and a few of the more important residence streets. The arc lamps are supplied at a yearly rate of $80 and the 25-cp incandescent lamps at a rate of $20 per year. The maximum commercial rate for energy is 10 cents per kw-hour. This rate is fixed by law. A sliding scale of rates with this maximum is in force. What is known as the company's wholesale rate averages about 5 cents per kw-hour.

The officers of the company are as follows: A. L. McDermott, president; G. H. Harries, vice-president; W. F. Ham, treasurer; H. W. Fuller, general manager; G. Campbell, purchasing agent; L. E. Sinclair, superintendent, and C. L. Heath, chief engineer.

New Power Plant for Legislative Group of Buildings in Washington.

Two years ago, when the arrangements for the construction of the new Senate and House office buildings were completed, it became necessary for the Government to consider immediately a central light, heat and power plant for the so-called legislative group of federal buildings. This group will be composed, when the last two mentioned are completed, of the Capitol, the Congressional Library and the House and Senate office buildings.

At the present time the Capitol and Library are supplied from individual plants. These isolated plants, two in the Capitol and one in the Congressional Library, while they are in fair condition, do not lend themselves to the expansion necessary to provide for the new buildings. The requirements of the new office buildings, in light, heat and power, will equal

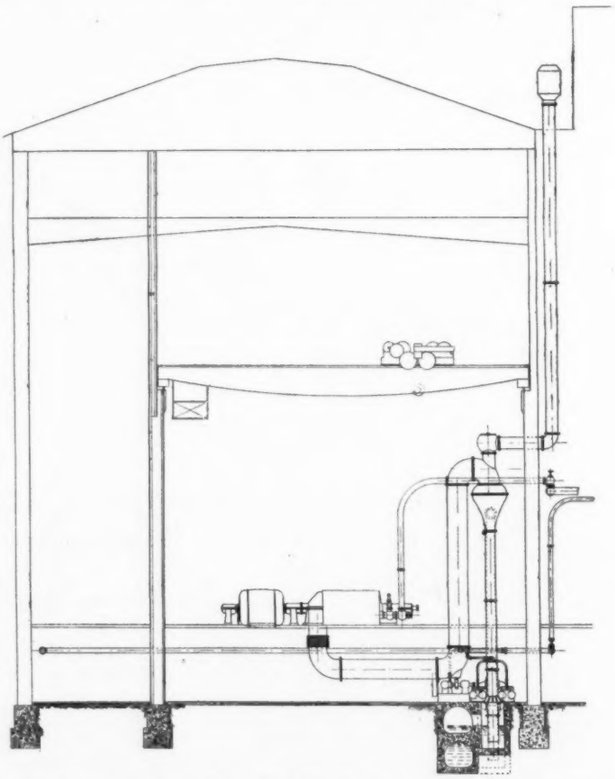


FIG. 1.—CROSS-SECTIONAL ELEVATION OF ENGINE ROOM FOR LEGISLATIVE GROUP OF BUILDINGS.

those of the Capitol and Congressional Library buildings combined; and considerations of economy and convenience prescribed a new central station for the entire group. Accordingly in 1905, engineers and contractors were requested to bid on the machinery equipment for such a plant, supplying their own designs and specifications. The building was to be provided by the Government. Bids for the mechanical and electrical installation of the building were received Sept. 30, 1905. After a thorough investigation the original plan for bidding was demonstrated to be impracticable and all bids were thrown out on July 4, 1906.

The plan of placing bidders on a uniform basis was adopted instead, and J. G. White & Company, of New York, were retained as consulting engineers to furnish a standard set of designs and specifications, and to assist the Government, generally, in receiving bids and awarding contracts for the machinery equipment. The design of the consulting engineers calls for a plant of 10,000 horse-power and the main machinery equipment has been decided upon. The details of the original plan relating to the provision of a building, by the Government, has been adhered to. The site chosen is Garfield Park on New Jersey Avenue, near E Street, S. E. Thus the maximum transmission distance is to the Senate office building, five-eighths of a mile.

In the design of the station as a whole, some of the points conducive to high station economy have been sacrificed for simplicity and regularity of operation. However, the principal features of the mechanical equipment will exhibit the most modern practice. In the specifications for the main prime movers, manufacturers were given the alternative between engine-driven and turbine-driven sets. Turbines were decided on, and the main equipment will consist of four 2000-kw Westinghouse turbine sets, and 16 500-hp Atlas water-tube boilers. Twenty-five cycle, three-phase current will be generated at a potential of 6600 volts, and the turbines will be equipped with barometric jet injectors. The boilers will be equipped with Roney stokers, and Foster superheaters.

At an early stage in the plans the advisability was decided upon of making the service of the federal plant co-ordinate with that of the Washington Railway & Electric Company. This prescribed the 25-cycle, 6600-volt basis of design, though the electric end of the plant is chiefly for lighting service. Motor-generator sub-stations are to be immediately established and equipped in each of the four buildings, and these will be supplied from the Bennings plant of the electric light company until the new federal station is ready for operation. The whole Government plant has been designed so that it will be interchangeable, either in whole or in part, with the Bennings plant. Exceptional freedom from interruption in the service of the system is thus guaranteed.

The sub-stations in the four buildings will contain, altogether, 16 400-kw motor-generator sets. The motors will be of the synchronous type, rated at 6300 volts. There will be five sets in the Capitol, three in the Library and four in each of the Congressional office buildings. These motor-generator sets will be equipped for starting from either the alternating or the direct-current end. The alternating starting equipment will consist of induction motors, direct connected and supplied with the current at 230 volts from transformers in the sub-stations. There will be three transformers in each sub-station with sufficient capacity to start any motor-generator set ten times, at intervals of two minutes, without a dangerous rise in temperature. The excitation for the motors will be derived from the main direct-current bus-bars in the sub-stations.

In the central station, the exciting current for the generators will be supplied at 120 volts, from exciters direct-connected to the main shafts of the turbines, in accordance with the ideas of the manufacturers. The original plan contemplated two steam-driven exciters, each with a capacity on overload sufficient for three generators. There will be provided in addition, an exciter storage battery with a capacity of 1600 amperes for 20 minutes, 800 amperes for one hour, or 400 amperes for three hours. The booster for this battery will be a direct-current motor-generator set, the motor being rated at 120 volts and having power sufficient to enable the generator to deliver 845 amperes for one hour at 65 volts. The circulating water for the plant will be taken from the Potomac River by means of a conduit. The details of this and other features of the mechanical end of the installation have not yet been worked out. It is expected that sufficient boiler capacity will be installed by the coming winter to heat all the buildings, and that electricity will be supplied for a time as previously mentioned from the Bennings station of the Potomac Electric Power Company. Should this not be feasible, the existing plants could continue longer in operation until the new power plant is completed. Descriptions of existing plants in Government Buildings in Washington will be published in a future issue.

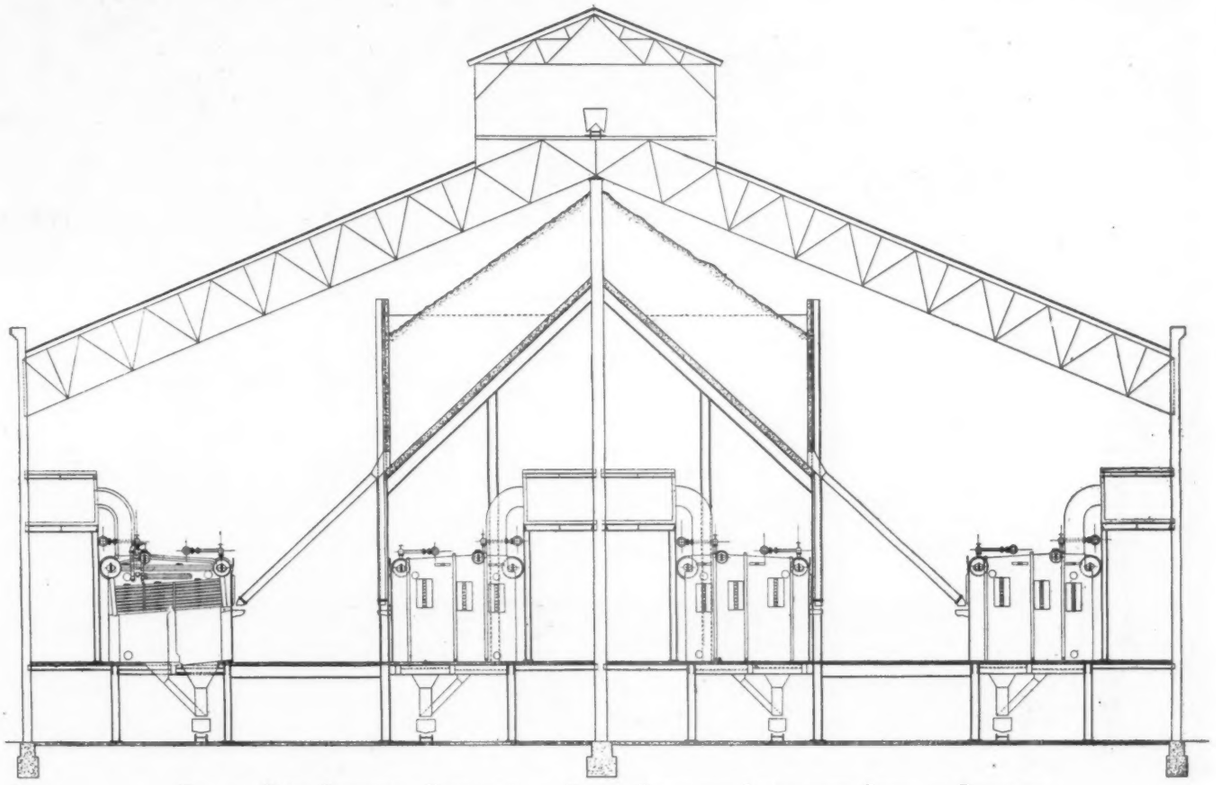


FIG. 2.—CROSS-SECTIONAL ELEVATION OF BOILER ROOM FOR LEGISLATIVE GROUP OF BUILDINGS.

Electric Automobiles in Washington.

One of the changes which has resulted in making Washington a beautiful city is the gradual displacement of the horse by the automobile. Washington has about 185 miles of streets which are paved with asphalt and which make automobile riding a pleasure. In addition to the streets of the city proper, there are possibly 50 miles of suburban drives, many of them located within Rock Creek Park, and which are very well macadamized. The roads through Maryland and Virginia, however, are not very good. The general result is that almost any point which it may be desirable to reach is well within the radius covered by electric automobiles and of these about 600 are now in use.

The first electric machines which were brought to Washington were of the types which have since gone out of use, because of their weight and small radius of action. Up to 1900, no electric machines could travel more than 20 miles on one battery charge. The upkeep also, of these early machines was found to be somewhat excessive, so that not very many people continued them in use for any great length of time. With the advent of lighter machines, and with a mileage of thirty to forty miles on one charge of the battery, their use became more extensive, so that within the past two years the number of electric vehicles in use in Washington has increased over 100 per cent. Several makers now claim from forty to fifty miles per charge, and two types of machines having a duplicate battery are expected to make 75 miles on one charge of the batteries.

Owing to the fact that very few of the operators understood the proper care of the batteries, the upkeep expenses were rather high. The Washington Electric Vehicle Company and the Pope Manufacturing Company both recognized the necessity of continuing their care of the machines after they were sold; but always claimed that there was no profit to them in thus looking after the machines. The Cook and Stoddard Company, which maintains the largest garage in Washington, early recognized the fact that proper care could only be given machines when experienced men were employed to look after them. The company was interested in the sale of the Baker Electric vehicles, and has among its customers a large number of doctors and many ladies who desired to be relieved of the entire responsibility of caring for the machines. The company further found that the proper care and maintenance of the machines resulted in the sale of others, while a few complaints regarding poor service resulted in unmerited condemnation of automobiles

FIG. 1.—A COMMON SCENE IN THE RESIDENCE SECTION OF WASHINGTON.

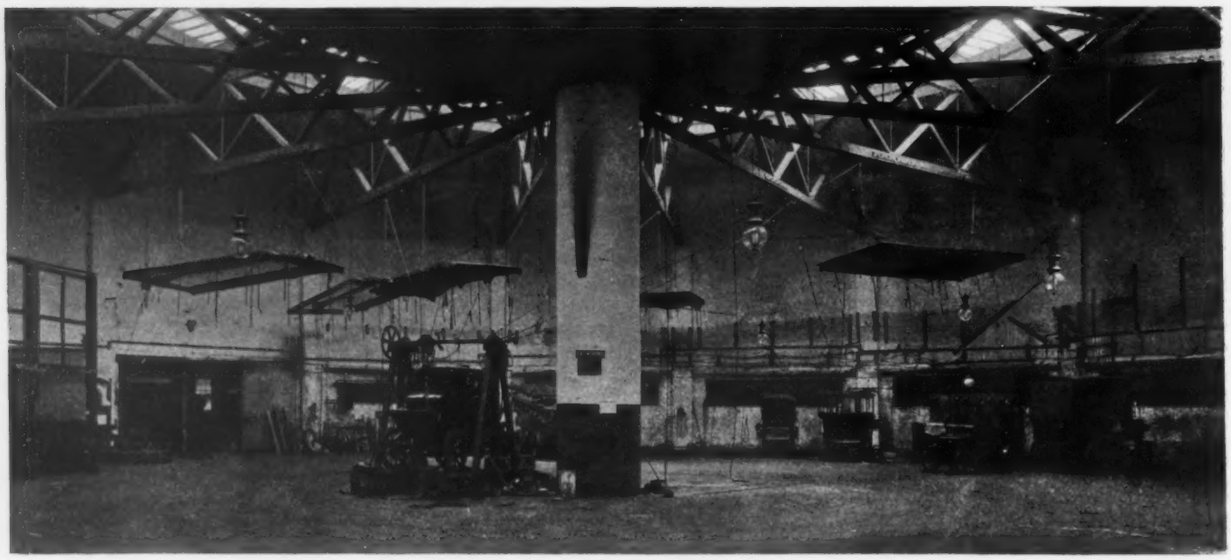


FIG. 2.—GARAGE IN OLD PANORAMA BUILDING WHERE SIGHT-SEEING CARS ARE CHARGED.

generally. The Cook and Stoddard Company therefore took up for consideration the establishment of a garage which should have separate departments for the care of electric and gasoline machines, each department being placed in charge of a thoroughly competent superintendent. For a stipulated sum per month the company provides for the entire care and maintenance of the machines, excepting extraordinary repairs. This care and maintenance includes the delivery of a machine in the morning to the owner's home, the sending for the machine when the owner had finished his use of it for the day, the washing and cleaning, the oiling and pumping up of tires, and the furnishing of electricity for charging the batteries.

In connection with this the company guarantees to physicians and others for an additional small sum per month, the uninterrupted use of a machine, so that if the owner's machine happened to be undergoing repairs he would be provided with a substitute with which he could make the calls necessary to his business. The satisfactory maintenance of this service has resulted in a large increase in the number of electric vehicles in service.

A service of this character, in order to be satisfactory, necessitated the employment of machinists, carriage washers, and chaffeurs for the delivery of the machines, in addition to night and day superintendence. Such a force of men brought about a fixed charge of such magnitude that the Cook and Stoddard Company was forced to provide a larger garage in which to handle a business large enough to warrant the maintenance of such a service. In locating such a garage as it had in mind the company had to consider the location of its various customers, and consequently sought a place from which the average distance traveled would be the shortest practicable. Such a place was found in the old West End Market at 22d and P Streets. This building has available two floors, which are approached independently without the use of an elevator. The upper floor, which is at the street level, is reserved for the use of the gasoline and steam machines; the lower floor, which is reached by an inclined driveway, is reserved for the electric machines, repair shop, and battery rooms.

One of the most important problems in the equipment of this garage was the matter of electricity for charging the electric machines. At first a private generating plant was considered, but was finally abandoned on account of the poor load factor, and because also of the fact that the Potomac Electric Power Company furnished electricity for automobile charging at rates which resulted in a considerable saving over what would have been the cost if a private plant had been installed. The garage is about a half mile beyond the limits of the territory supplied from the direct current mains of the electric lighting company, and two methods for supplying electricity were available; a direct current at 550 volts could have been secured from the conductors of the Metropolitan Railway for the operation of motor-generators; but the efficiency of motor-generators and the fluctuation in voltage would have resulted in comparatively poor conditions of service; single-phase current was also available through the medium of rectifiers.

Previous to the selection of this new location a complete set of tests had been made on alternating current rectifiers of both the General Electric and the Cooper-Hewitt makes. The conversion efficiency of the rectifiers was found to be about 80 per cent when delivering current at 110 volts, and was quite uniform at all loads within the limits of the rectifier.

When charging automobiles from the direct current mains considerable energy is lost through rheostats, and when this is taken into consideration, and it is remembered that practically no regulating resistance is required in the direct current circuit of the rectifier, the use of the alternating current rectifier results in no greater consumption of energy per machine.

The Baker electric vehicle is built in several styles, requiring 12, 14, or 24 cells. The lighter machines require a voltage not exceeding 37, and the 24 cell machines require a voltage not exceeding 65.

It has been customary from the first to charge these machines in series circuits arranged to get the best advantage from the voltages supplied by the Edison mains. Since the installation of the rectifiers the series method has been retained, as many as six small machines being charged in one circuit.

FIG. 3.—MERCURY CHARGING BOARDS IN COOK AND STODDARD COMPANY'S GARAGE.

On acccount of the fact that the principal loss in the rectifier is a voltage loss of about 15 volts which is not affected by the voltage of the supply circuit, the great advantages of operating at high voltage were recognized, and a contract was made with the General Electric Company for the supply of five panels, and with the Cooper-Hewitt Company for the supply of three panels, each of which would have a capacity of six machines in series, and equipped with 40 ampere tubes. As the charging rate is usually about 20 amperes, each panel is capable of charging two parallel circuits of batteries, each containing nearly 100 cells, and by varying the reactance connections it is possible to charge any combination of cells from 12 up to 100 cells.

The general results from the use of rectifiers have been fully as favorable as where the charging has been done from direct current circuits, and the net efficiency has been about the same; that is, the number of kilowatt hours consumed per machine has, if anything, been slightly less than when the charging was done from the Edison mains.

Since the alternating current rectifiers have proven so satisfactory in operation at the Cook and Stoddard Company's garage a complete equipment of them has been installed in two other places in the city—at L. P. Dorsett's, 17th and U Streets, and at the Rock Creek Auto and Wagon Works, at Pennsylvania Avenue and Rock Creek. Two other smaller garages use the rectifiers, but the charging at six of the principal garages in the city is done from the Edison mains at 110 and 220 volts.

The Cook and Stoddard Company is, however, only one of the companies operating in Washington. There are at the present time in operation nine large garages for the accommodation of private machines. In addition, there is one garage which cares for business vehicles principally, including the many large sightseeing automobiles which are a feature of the capital. This garage is very suitably located in the old Panorama building which was built for the exhibition of the immense panorama paintings of the Civil War battles. The interior of this garage, which is located not far from the B Street station of the Potomac Electric Power Company, is shown in Fig. 2.

The Adams Express Company is carrying on its entire work in Washington for collection and delivery through the medium of electric wagons, of which they have thirty, the energy being supplied by the Potomac Electric Power Company. These vehicles are all fitted with the Edison battery.

The United States Express Company carries on the bulk of its work with twenty-five electric machines, energy for which is obtained from a private plant, consisting of producer gas engines direct connected to direct-current generators. This plant has just been installed and we expect to publish some interesting facts regarding it in a future issue.

The Dupont Garage Company is one of the latest arrivals in the field, and, in addition to its large three-story building at 2020 M Street, has recently purchased the business of the Washington Electric Vehicle Company, which handled the Columbia machines. The garages at these two locations will be operated by the Dupont Company, the lighter machines and pleasure vehicles generally being cared for at 2020 M Street, and the old Panorama building, which was formerly operated by the Vehicle Company, being reserved for business machines as stated before. The Dupont Company has, at the present time about seventy electric runabouts in its care, the average consumption for charging which was, in the month of April, 80 kilowatt hours, which was supplied from the direct current mains of the Potomac Electric Power Company.

With regard to the mileage traveled, the Adams Express Company's wagons travel between 24 and 30 miles per day. The electric runabouts used by physicians range from 15 to 30 miles per day, with an average of about 20. A number of electric runabouts which are used by some of the business men of the city average from 20 to 25 miles per day. These figures are taken from the records of the companies having the various vehicles in charge.

Fig. 4.—Interior of the Dupont Garage on M Street.

The Luttrell Company is the latest to bid for a share of the local patronage. This company is the agent for the Babcock electric vehicle, which are claimed to be the lightest running vehicles on the market.

Looking back for several years and realizing how greatly electric vehicles have been improved, it is to be wondered how they ever found a sale at first. It is questionable if there ever was another line of goods precipitated on the public that represented so much money-value invested that was of such little value, practically.

The modern electric vehicles are not machines but carriages, with much lighter batteries, more efficient motors, and having a fairly large mileage capacity. The popularity of the electric vehicle is increasing very rapidly, due to these improvements and to better charging facilities and provisions for caring for the machines.

The capital is an ideal city for the use of electric vehicles, because of its many miles of shaded asphalt streets and also to the absence of any grades, for generally speaking the city is perfectly flat. The roads outside the city being so very poor, there is little call for gasoline touring cars, although there are many in use in the city. In no other city, however, are there as many electric vehicles to be seen in constant use, and especially by women. With a single exception, all the garages are supplied with energy from the Potomac Electric Power Company at what is termed its wholesale rate, which averages about 5 cents per kw-hour.

Lighting of the Jamestown Ter-Centennial Exposition.

THE Jamestown Ter-Centennial Exposition now being held on the shores and waters of Hampton Roads, Virginia, commemorating the three-hundredth anniversary of the first permanent settlement in America by English-speaking people, at Jamestown in 1607, is in many respects a novel exposition, in that it is primarily a military and naval celebration. No effort has been made to surpass previous expositions in the point of magnitude; but the fact that the Exposition is located on historic Hampton Roads, immediately opposite Fortress Monroe, and is the world's first Seaboard Exposition, makes it a historic memorial in a harbor where there is more than enough anchorage for all war fleets afloat; and as representative vessels of the navies of the world are at anchor in the Roads during the Exposition period, the sight is one long to be remembered.

The entire architectural scheme of the Exposition buildings is Colonial, and the visitor is impressed with the absence of towers, etc., which are generally associated with exposition buildings. The scheme of construction is entirely new, and the effect is a very pleasing one, as all of the buildings are either permanent structures of brick, or finished with a veneer of brick which gives an air of permanence that has never, heretofore, been obtained.

The illumination of the Exposition grounds and buildings has been carried out, as far as possible, in keeping with the general architectural scheme. The treatment of the entire water front, including the United States Government's ornamental pier, extending 1250 ft. into the water and which is 600 ft. in width, is by means of ornamental lighting standards of uniform height and design, carrying clusters of incandescent lamps enclosed in sand-blasted globes. This makes a very impressive sight from the many pleasure boats which constantly ply to and from the commercial piers, which are located at either end of the exposition grounds. These are 2500 ft. long and are approximately two and one-half miles apart.

The decorative lighting on the large exhibit buildings is by means of 8-cp incandescent lamps placed on approximately 12-in. centers. These are arranged in such a manner as to emphasize the architectural line more distinctly than has been accomplished at former expositions, and at the same time they give a mild, even distribution of light that is not at all trying to the eye. What may be classed as one of the most unique and pleasing features of the night illumination is the "building up" of the light. This is done by means of a three-phase, 2300-volt, water rheostat having a capacity of 2500 kilowatts. The process of "building up" the lamps to full brilliancy requires about four minutes. The water rheostat is also employed in extinguishing the decorative lighting, the whole gradually dying away to complete darkness.

The use of projector searchlights for spectacular effects has been adopted for the first time in exposition lighting. A large number of 30-in. projectors are used for this work, in addition to numerous smaller ones; and at certain hours in the evening all projectors on the War Path, which are mounted on steel towers, 75-ft. high, are played on the mirror basins in the Main Court as well as the Government Pier and battleships at anchor in the Roads. The effect produced is spectacular in the extreme.

FIG. 2.—ENTRANCE TO AUDITORIUM.

On "special" days, there are special lighting effects provided, such as the outlining of battleships at anchor in the Roads, and the view from the waterfront on such occasions is one that few people see and one that is impossible for the photographer to do justice to, on account of the constant movement of the ships, their distance from the shore and the time necessary for a night photograph.

What may be termed a novelty in lighting, is that provided along what is termed "Flirtation Walk," where lamps are placed at irregular intervals along the walk and in the trees and arbors adjacent. All the lamps in this section are equipped

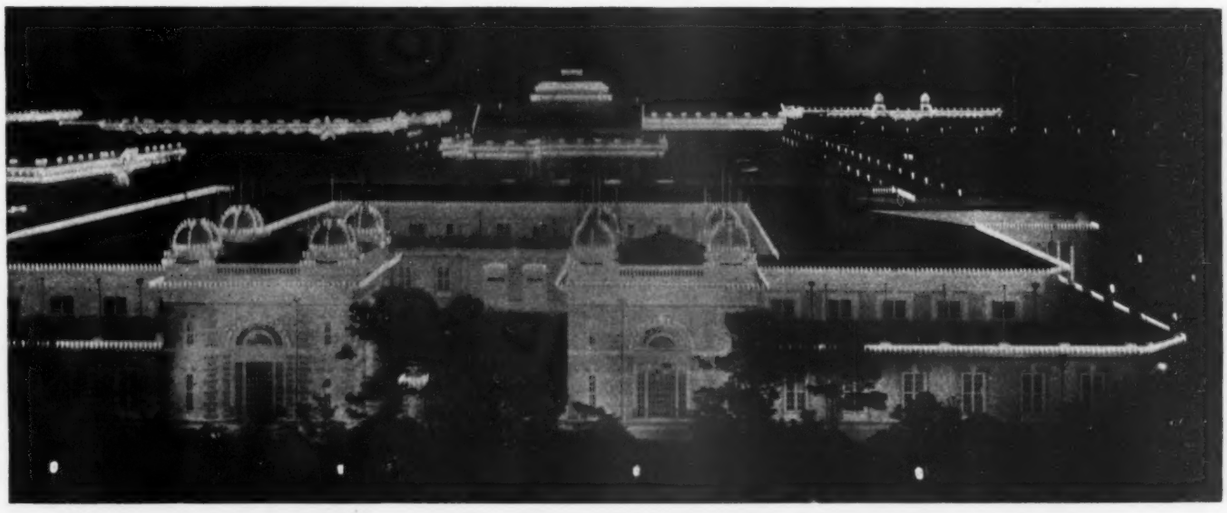


FIG. 1.—BIRD'S-EYE VIEW OF A PORTION OF THE EXPOSITION GROUNDS FROM PROJECTOR TOWER.

FIG. 3.—METHOD OF LIGHTING BOARD WALK.

FIG. 4.—LOOKING DOWN POWHATAN STREET.

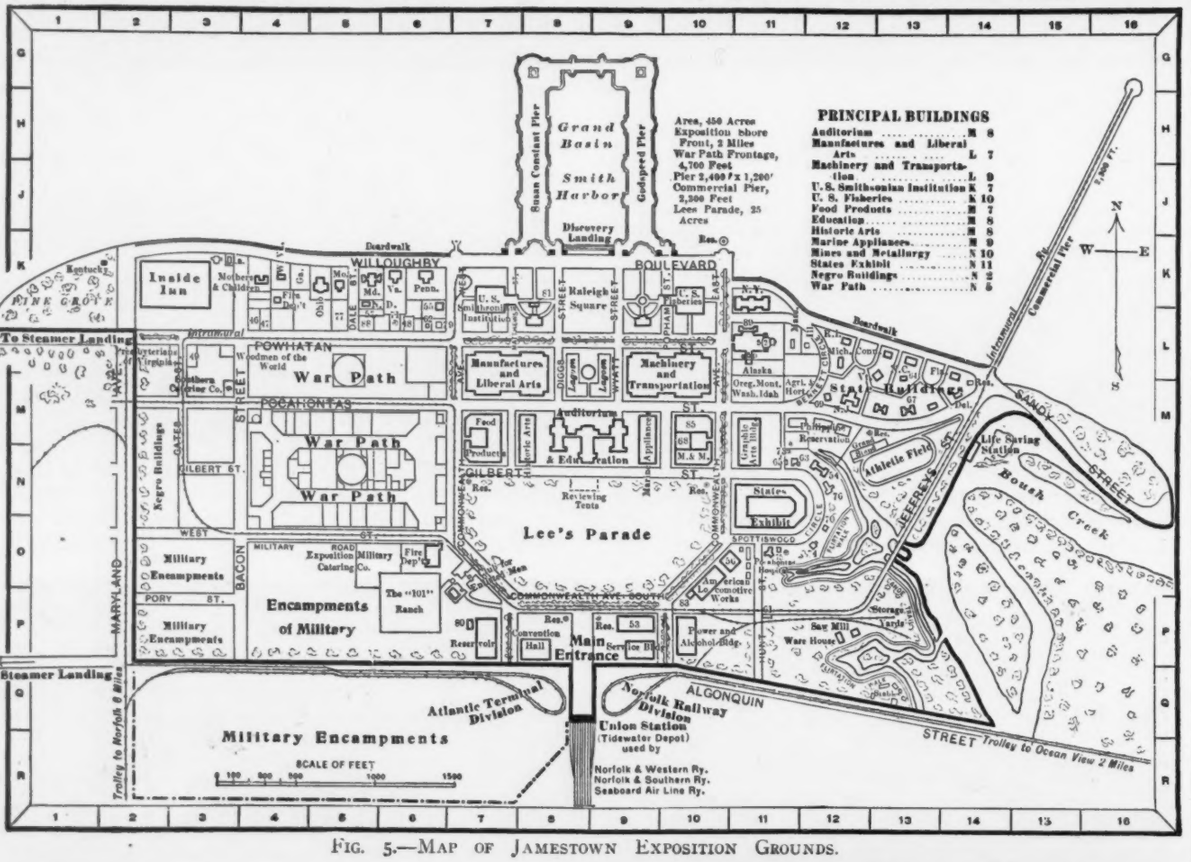


FIG. 5.—MAP OF JAMESTOWN EXPOSITION GROUNDS.

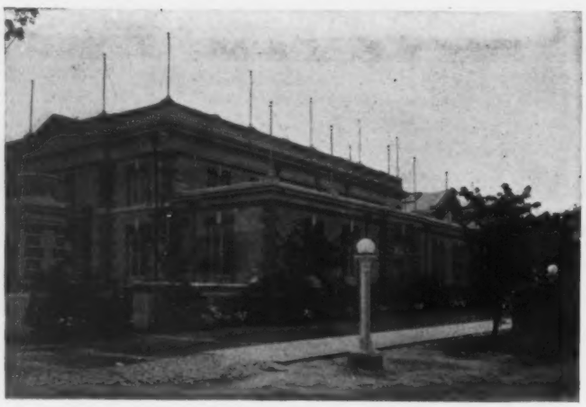


FIG. 6.—LIGHTING STANDARDS ON POCAHONTAS STREET.

FIG. 7.—EAST FRONT OF MANUFACTURES BUILDING.

LIGHTING OF THE JAMESTOWN TER-CENTENNIAL EXPOSITION.

with specially constructed "skee-doodle" sockets, which allow the lamp to remain extinguished a much greater length of time than the commercial socket would. The result is a firefly effect as well as some surprises to sentimental couples frequenting the walk.

FIG. 8.—UNITED STATES GOVERNMENT BUILDING AND COLONNADE.

FIG. 9.—AUDITORIUM BUILDING.

The electrical fountain, which is located in the Main Court between the two mirror basins, will be of much interest to the general public and will become one of the features of the night display, in connection with the concentration of all projectors on the basins and fountains at certain intervals during the evening.

The requirements for lighting and also for motor service on the Exposition Grounds are approximately 6000 kilowatts, which is supplied to the Exposition Company by the Norfolk & Portsmouth Traction Company from its new power station in Brambleton outside of Norfolk. This station is equipped with four 3000 and one 1500-kw. three-phase, 60-cycle Curtis turbines generating current at 11,000 volts. This is transmitted at this potential a distance of eight miles to the Exposition Grounds over two three-phase transmission lines. One line is

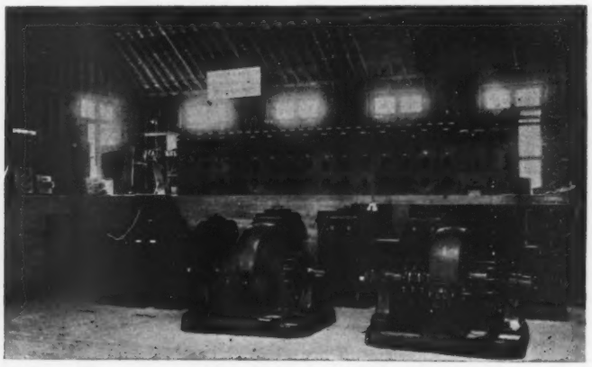


FIG. 10.—EXPOSITION SUB-STATION IN COURSE OF CONSTRUCTION.

FIG. 11.—LIBERAL ARTS BUILDING UNDER RAYS OF SEARCHLIGHTS ON WARPATH.

located on the traction company's right of way, by way of Ocean View, and has a rated capacity of 2000 kilowatts. The other line is over the right of way of the Tidewater Railroad Company, and has a rated capacity of 4000 kilowatts. Both the transmission lines terminate at the Exposition sub-station

FIG. 12.—SOUTH ENTRANCE TO MANUFACTURES BUILDING UNDER RAYS OF SEARCHLIGHTS.

located in the Machinery and Transportation Building, at which point the energy is metered and delivered to the Exposition Company.

The equipment of the sub-station consists of three 1400-kw, 11,000-2300-volt, three-phase, air-blast transformers, two 500-kw rotaries with the necessary transformers, etc., and three 100-light series alternating-current arc lamp transformers. The control of this apparatus is from the main switchboard located on the switchboard gallery. This board is made up of seven 11,000-volt panels, one water-rheostat panel, eleven 2300-volt distribution panels and two 500-volt direct-current panels. All 11,000-volt and 2300-volt switches are of the remote control type, the switches themselves being located in a reinforced concrete structure under the gallery, where the bus-bars are also located. The bus-bars are in duplicate, one set being in two sections, connections being made between sections by means of a three-phase, 2300-volt, water rheostat and a short-circuiting oil switch which is used to control the decorative lighting circuits. The six remaining circuits are used exclusively for commercial lighting and motor circuits. All distribution from the sub-station is underground, and the 11 circuits terminate in fireproof structures at different points throughout the grounds. Twelve of these structures are used exclusively for static transformers, and two are motor-generator stations.

Each motor-generator station is equipped with two 100-kw. 110-220-volt direct-current generators, driven by a three-phase, 2300-volt, 60-cycle induction motor. One generator station which is located in the Auditorium Building, is used during the day for furnishing energy to the United States Government and the Exposition Company's Exhibit Buildings. During the evening it is used exclusively for projector searchlight service. The station on the War Path, or Concession Street, is for service to the several concessions requiring direct-current for stage lighting and projector work.

All distribution in the central portion of the grounds and the War Path is underground and outlying districts are taken care of by overhead construction. The incandescent lighting throughout the grounds is carried exclusively on the 110-volt, three-phase, 60-cycle service and all heavy motors are fed from the 500-volt direct-current service. All special lighting for stage work is on the 110-220-volt direct-current service. The service delivered to the concessionaires and exhibitors is furnished at the rate of 6 cents for lighting circuits and at 4 cents per kw-hour for motor circuits, with a discount of 10 per cent. This is an exceptionally low rate considering the original cost of the installation and the shortness of the contracts (seven months). The idea is to offer every inducement to the concessionaire and exhibitor to make a brilliant electrical display at a reasonable cost.

The series, alternating-current, arc lighting system is used exclusively for patrol lighting, such as the aisles of all Exhibit Buildings, the entire fence enclosing the Exposition Grounds, and the military encampments which cover about 100 acres of ground adjacent to the Exposition Grounds.

The entire electrical installation was designed and installed by the Department of Electricity of the Jamestown Exposition Company in a comparatively short time, considering the many disadvantages under which the department was placed. The department was created in July, 1906, and actual construction was not commenced until late in September of the same year. Mr. W. M. Dixon is chief of the department.

Electric Service Plant of the Jamestown Exposition.

The new power station of the Norfolk & Portsmouth Traction Company at the foot of Lovitt Avenue, Brambleton, on the outskirts of Norfolk, is the source of electrical supply for the Jamestown Exposition. This station was built in a remarkably short time due to the energy of E. C. Hathaway, the general manager of the company, and H. Root Palmer, its general superintendent. Work on the foundation was begun last July, and on April 10, 5000 horse-power of electrical energy was being generated. Within a few weeks, the equipment in the power station will be complete and the plant will be capable of turning out 20,000 horse-power.

The boiler equipment comprises 16 512-hp water-tube boilers arranged in two rows facing each other and designed for a working steam pressure of 200 lbs. The furnaces are equipped

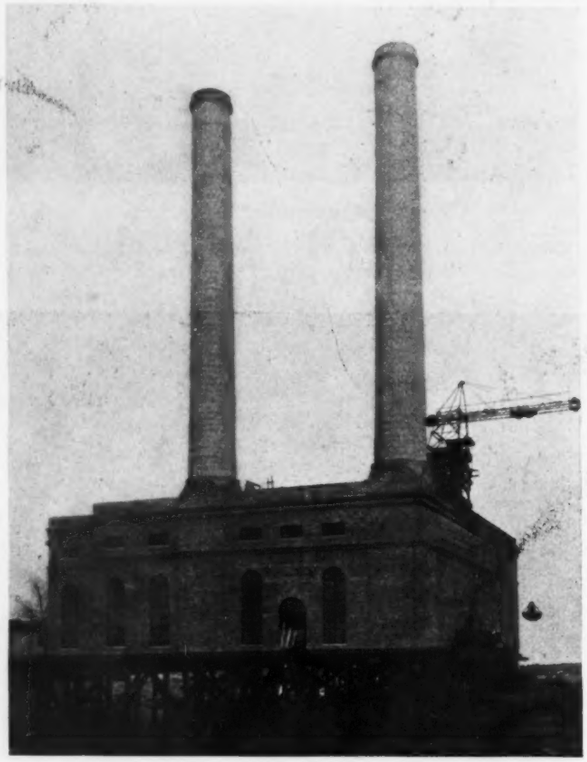


FIG. 1.—COAL HANDLING ARRANGEMENT AT NORFOLK AND PORTSMOUTH TRACTION COMPANY'S NEW STATION.

with Roney stokers and superheaters are provided for superheating the steam 150 degrees above the temperature of saturated steam. The steam piping is arranged with special bends in order to reduce the number of joints and on the main line

the valves are operated by small motors. Above each boiler is a coal bunker having a capacity of 150 tons.

Coal is received by rail or by water, and is taken by buckets to the top of the building. After passing through crushers it is delivered to the bunkers, whence it passes through chutes to the stokers. The coal-handling apparatus is electrically driven and has a capacity of 70 tons per hour. From the time the coal leaves the boat or car until it comes out in the basement as ash and is dumped into cars, no human hand touches it. The station is provided with two brick stacks, one opposite each row of boilers. These stacks are 220 ft. high and have an inside diameter of 12½ ft.

A feature of the station is the arrangement for receiving the condensing water. This is taken from the river through tunnels which are arranged so that water from the discharge cannot come in contact with the water entering the intake tunnel. This is due somewhat to tidal conditions also.

In the engine room are installed three 3000-kw and one 1500-kw, three-phase, 60-cycle, 11,000-volt Curtis turbine sets, with the necessary condensing equipment. Two 75-kw and one 25-kw turbo-exciter sets are provided. The operating floor extends the entire length of the building and is elevated above the turbine room. Beneath this floor are the high-tension switching devices, bus-bar compartments and connections for the outgoing feeders.

For convenience in installing machinery, a railroad track connecting with a spur track outside the power house, runs into the turbine room. This track is situated between the turbines and the operating floor or gallery, so that the machinery may be taken directly from the cars by the large electric crane with which the power house is equipped, and deposited in any part of the turbine room. All switches are electrically operated, so that the operator is not called on to handle or be in close proximity with high voltages. The switchboard is located at one end of the operating floor to the right of the oil switches shown in Fig. 2.

The transmission of electricity to the various sub-stations is by 11-000 volt cables and not a single overhead line leaves the new station. There are installed on the operating floor four 110 and four 200-kw air-cooled step-down transformers for supplying the immediate territory with energy for lamps and motors. There are also two 500-kw, 550-volt rotaries with their transformers installed on this floor. The energy from these is used for street railway service in the vicinity.

There are three sub-stations connected with the power house, one at the old power house on Cove Street, one in Portsmouth and one at Ocean View. These receive current at a potential of 11,000 volts and by means of rotaries and transformers distribute the energy at a lower tension for lamp, motor and street railway circuits. Both alternating-current and direct-current services are maintained. A feature of the transmission system is the installation of two cables between the power house and sub-stations each of which is sufficient to carry the entire load. These are arranged so as not to come in contact with each other at any point, and under normal conditions the railway load is carried by one and the commercial lighting and motor load by the other.

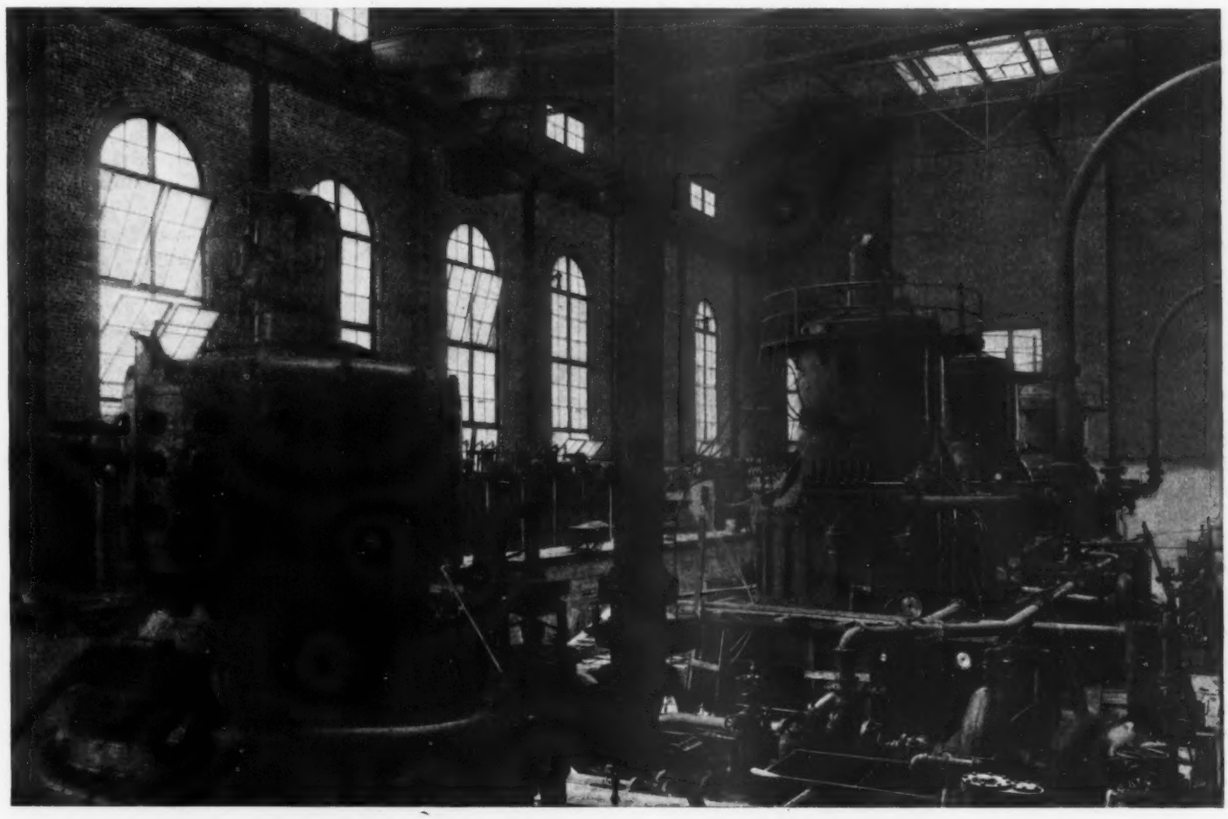


FIG. 2.—INTERIOR OF NEW POWER HOUSE OF NORFOLK & PORTSMOUTH TRACTION COMPANY.

The transmission line to Ocean View sub-station has been constructed for 2000 kilowatts additional capacity, and the line from Ocean View to the Jamestown Exposition Grounds is built to supply this amount of energy during the Exposition. An additional temporary line runs direct from the power house to the exposition by way of the Tidewater Railroad right-of-way. This line is of No. 0000 wire and supplies the Exposition with the balance of the 5000 kilowatts contracted for. The distribution system complete will supply the territory within the points of Pine Beach, Willoughby Spit, Ocean View, Chesterfield Heights, Indian River Park, Money Point, Gilmerton, Churchland and Pinners Point. We expect to publish in a later issue a more detailed description of the new power station and the distribution system.

The Principles of Modern Rate-Making for Electric Light and Power.

The making of prices for electric light, heat and power is largely a question of determining the operating cost of production and distribution plus interest and depreciation on the producing and distributing plant. The competition of other sources of light and power makes it important to determine these costs as accurately as possible if the company is to make prices which can get the business to enable it to earn a fair return on its investment. It is an easy matter for an operating company to determine its total cost of production per kw-hour if all of its output is metered. This is simply a question of adding together all the expenditures for operation and maintenance for a given period, adding to that the interest and depreciation for that period and dividing this total by the number of kw-hours' output for the period. The most uncertain factor is depreciation. For this a certain figure has to be assumed, usually 5 or 6 per cent, for a modern plant. The other expenses are definitely known if the company keeps accounts. For example, suppose a plant put out 438,000 kw-hours in a year and that the cost of operation and maintenance was $11,520 and that the interest and depreciation figured at 12 per cent on the investment of $50,000 was $6,000. The total operating and fixed charges of $17,520 divided by the output of 438,000 kw-hours gives a total cost of 4 cents per kw-hour.

The foregoing is simple, but it is as unsatisfactory as it is simple to the man who wants to know what it costs to serve different classes of customers. He may see from his books that most of his customers are paying far more than the cost of production according to these figures, yet the plant is not earning a very great surplus. Of course, some of the discrepancy comes in under the head of lost and unaccounted for current, including slow meters on customers' premises, line loss and leakage; but this does not begin to account for all the discrepancy. The fact is, it is probably costing much more than 4 cents for the majority of customers and less than 4 cents for a few large customers. Since 4 cents is simply the average figure, it tells but little about how the cost is distributed. What is being lost by serving one class of customers is paid by another class, but the loss on certain classes is great enough to nearly offset the profits on others.

There are those that have maintained that it is right and proper that all classes of customers be served at the same price regardless of the cost of serving them, provided the receipts average up well enough to make a profit. Such arguments are usually actuated by the great difficulties found in separating out and determining closely the cost of serving each individual customer. They are certainly not based on equity. However, it will not do to give up the task of separation and analysis of cost altogether simply because a complete and minute separation is impossible. There is a happy mean. The classification question is too important to be neglected by a company that is in the central station business to get the best returns on its investment. It is important, because only by classifying can a system of rates be arrived at which will capture and hold some of the best-paying business. Certain classes of business, notably those giving a load a large number of hours per day, are profitable at a very low rate. Very likely many of them cannot be secured and held except at a very low rate. On the other hand, there is some business which is unprofitable at any prevailing rate, and upon which it would be the height of folly to reduce the rate. Such business must be considered mainly for its advertising value and in some cases as an entering wedge for future profitable business. While it may not be feasible or advisable to increase the rate on business that analysis shows unprofitable, such analysis will at least tell the business on which the rate should not be reduced.

In determining the cost of supplying a certain class of business, it is customary for convenience to separate the fixed charges from the operating charges. Some charges, such as interest, depreciation, taxes and insurance, are fixed at a certain point, regardless of the number of kw-hours a station generates per year, although theoretically this is not strictly true of depreciation, which depends partly on how much the machinery is used. Operating charges, such as fuel, are dependent largely on the kw-hours output. In large plants the cost of labor varies with the kw-hour output, but in small plants labor is frequently more in the nature of a fixed charge, since there is a minimum amount of labor which cannot be reduced no matter how much the output is reduced.

With these principles in mind the next step in analyzing the cost of supplying different classes of business may be taken up for consideration. Suppose, by way of illustration, that a certain company has a total permanent investment equal to $250 per kilowatt of maximum station capacity; machinery counted as reserve, over and above the maximum peak load not being counted, of course, as capacity. Assuming that 6 per cent interest should be paid on this permanent investment and that depreciation of 6 per cent should be allowed either in the shape of a sinking fund laid aside or in replacements and enlargements of the plant, the company should evidently pay 12 per cent on $250 or $30 per year for each kilowatt of station capacity to provide for interest and fixed charges. Now this $30 per year fixed charge should evidently be distributed among the consumers for whose benefit the investment is made. The amount which should rightly be charged a consumer for his share of such a fixed charge will, of course, depend upon two things; the amount of power plant capacity that he requires on an average during the peak load period and the amount of distributing system investment that has been made to reach and serve him. The two are as a matter of fact usually taken together. It is not considered feasible to separate the distributing system investments required to serve different customers, as this would complicate matters so very much that no rate system taking it fully into account could be worked in practice.

About the only approximation of such a practice that is found in actual work is the custom which some companies have of charging higher rates in the scattered residence districts than in the business district, one reason for such higher rates being the greater cost of the distributing system necessary to reach the residences, but here also other factors enter in, such as the small amount of revenue per customer and the bookkeeping necessary to keep a customer's account. Aside from this differentiation between residence and other customers, there is usually little chance to charge each customer with his relative proportion of the fixed charges on the distribution system, and each is, therefore, simply charged with his share of the total investment in the property. The customer should evidently pay fixed charges on whatever kw-capacity of the entire plant is kept in readiness to serve him.

If $250 is invested per kilowatt of generating capacity and a customer has a load the maximum of which occurring during the peak-load period of the year, is one kilowatt, that customer should evidently pay, according to the previous calculations, $30 per year to cover fixed charges, and in addition to that he should pay the station and office operating expenses incurred in serving him. If the customer uses his one kilowatt an average of only one hour a day for 300 working days in a year his fixed charges alone on 300 kw-hours, being $30 per year, amount to 10 cents per kw-hour. For a two-hour per day use these fixed charges are reduced one-half or to 5 cents; while for eight hours per day they are 1.2 cents and for 24 hours per day, 0.4 cent. It is thus seen how important a part fixed charges play in the making of equitable rates. It is also seen that it is of vital importance to classify business in some way so that the business which is on for a number of hours per day shall not pay an unjust portion of the fixed charges caused by the business which is on an hour a day or less. The practical results of a rate which charges the long-hour user too much is to drive that class of business away from the central station company to other methods of securing light and power, leaving the central station company with the most unprofitable business as its principal load.

In what has gone before, it is seen that a rate which is proportional to the cost of serving any given customer should be made up of a fixed charge to cover interest, depreciation, taxes and bookkeeping plus a certain amount per kw-hour to cover operating costs. These should be the elements making up the customer's total bill, though it is by no means necessary that they be itemized or separated on the customer's contract or on his bills. The point is to have the actual amount of the bills he pays correspond somewhere near with the sum of the fixed and operating charges which he should rightly pay. There are a number of methods of arriving at approximately this result which it is the purpose of this article to describe.

The principal difficulty run across in applying these principles is to determine how much of the capacity of the station is actually required by a given customer during the peak load periods. What happens during periods other than peak load does not concern the central station manager, as he has enough idle investment to carry any kind of load that will come along. It is the winter peak loads that usually determine the maximum investment and loads on at that time should bear their full share of the investment expense. Nearly all lighting comes under this head, as there is very little lighting that is not on during the winter peak period. With power and heating or cooking it is different. Motors and heating devices which are used intermittently may or may not be on during the peak.

The proper procedure in this case is to determine what percentage of the connected motor load of this character is actually on at one time during the peak. This will be considerably less than the connected motor horse-power and constitutes what is sometimes known as the diversity factor. It is manifestly unfair to charge a motor for a station capacity sufficient to operate it at full load during the peak when, as a matter of fact, a group of these motors, as actually operated intermittently from central-station service, would never have a maximum demand anywhere near their combined horse-power. The station capacity rightly chargeable to a motor would consist only of its average maximum demand during the peak period. This diversity factor frequently makes it possible to give lower rates on motors and electric heating and cooking devices than would be possible if they were all chargeable with the maximum demand on the station that they might create if all turned on at once during the peak.

To put the matter in another way, the same station capacity which is supplying certain pieces of apparatus at one instant may be supplying different ones the next. This question is coming up at the present time frequently when rates are being made for electric heating and cooking. If a central-station company were to figure that each kilowatt or capacity in electric-heating devices connected should pay, for example, at the rate of $30 per year fixed charges and to that should add operating expenses, very little progress would be made in that kind of work. The same would be true of intermittent power, for the reason that the fixed charges would be so heavy as to scare the customer away before he began. When we consider, however, that the actual demand on the station during the peak can only be a small fraction of the total connected kilowatt of the motors or heating appliances, it is seen that the portion of the rate intended to cover fixed charges can be very much reduced from $30 per year per kilowatt. Having outlined some of the fundamental principles in rate-making, it is now in order to consider some of the principal and most successful systems of charging in use. All of these repose more or less upon the principles advocated before the British central-station public by Mr. Arthur Wright, 12 or more years ago, which crusade in favor of rational rate-making attracted world-wide attention.

THE DOHERTY READINESS-TO-SERVE SYSTEM.

One of the most easily understood methods of charging, in which an attempt is made to separate the fixed and operating charges, is the readiness-to-serve rate, which is sometimes known as the Doherty rate because first publicly proposed by Henry L. Doherty. This rate has been adopted by a number of central-station companies, both large and small. Under this plan the customer pays a fixed readiness-to-serve charge each month without regard to the amount of energy that is consumed, and in addition pays a very low rate per kw-hour for what energy he consumes. The readiness-to-serve charge is supposed to take care of the fixed charges such as interest, depreciation, taxes and fixed office expenses, which are independent of the number of kw-hours turned out per year by the station. This plan has been modified in many ways by various companies, but as originally adopted at Denver it consists of the following: First, a service charge of $1 per customer per month, plus, second, a readiness-to-serve charge of 15 cents per 16-cp lamp connected per month; plus, third, a charge of 5 cents per kw-hour for whatever current is used. The service charge of $1 per customer is to cover meter and bookkeeping expenses. The readiness-to-serve charge is to cover interest, depreciation and other fixed charges on power station and distributing system. If 50-watt lamps are used a charge of 15 cents per month per 50-watt 16-cp lamp is the equivalent of $3 per kilowatt per month. Other companies adopting the readiness-to-serve system have varied this charge somewhat, some being as low as $2 per kilowatt and others as high as $4.50 per kilowatt. As a general rule, the higher the readiness-to-serve charge the lower the rate per kw-hour.

To work out a practical example figuring a customer's bill under the readiness-to-serve charge, suppose a customer has an installation of 20 50-watt lamps at 15 cents per lamp. This will make his readiness-to-serve charge 20 × $0.15 or $3 per month. Suppose also that his energy consumption amounted to 78 kw-hours, and that the rate is 5 cents. The customer's bill as rendered at the end of the month would, therefore, be as follows:

Service charge	$1.00
Ready-to-serve charge	3.00
78 kw-hours at 5 cents	3.90
Total	$7.90

If he had paid, say, a straight meter rate of 12 cents per kw-hour, his bill would have come to $9.36. If he had used twice the number of kw-hours his bill, under the readiness-to-serve system, would be $11.80; while under the straight 12-cent rate it would be $18.72. It is thus seen that the readiness-to-serve system is primarily a system to give the long-hour user the rate to which he is entitled without making concessions which the company cannot afford to make to the short-hour unprofitable customer. The practical commercial result of the readiness-to-serve system in the cities where it has been adopted has been to encourage the most profitable class of customers, namely, those using energy many hours per day. This, of course, is exactly what the central-station company should strive for. It has also encouraged those who have been economizing in energy to be more liberal in its use and to keep lamps burning a greater number of hours for lighting stores after closing time, lighting show-windows, etc.

When the readiness-to-serve system is applied to residence districts or, in fact, to any class of business where the full connected load of a customer is not turned on regularly during the station peak, it is necessary to modify the method of figuring connected load. If this were not done the readiness-to-serve charges would be unfair and exorbitant. For example, a residence customer with 30 lamps connected would not think of paying 15 cents each or $4.50 per month simply as a readiness-to-serve charge, nor would it be fair to make such a charge in the case of a residence because the full connected load is seldom turned on, and almost never at the time of the station peak. It is fair in such cases to figure as connected load only that which ordinarily comes on the winter station peak, and this is only from one-fifth to one-third the capacity of the lamps connected in a residence. In the cases of churches, theaters and hotels some deduction should also be made because of the fact that the connected load at these places is seldom on during the peak. With these modifications the readiness-to-serve system can be made to apply to all classes of customers. Some stations have so applied it, although in the majority of cases where it has been adopted it has been

used mainly as a method of getting commercial business. One plan is to give the customer the choice between the readiness-to-serve contract and a straight meter rate of from 10 to 15 cents per kw-hour. The result of this has been to change customers using energy many hours per day over the readiness-to-serve contract, while the short-hour user retained the old straight meter rate. The short-hour customer would find no advantage in taking the readiness-to-serve contract.

MULTIPLE-RATE SYSTEMS.

Another system which provides very well for the fixed charges which are such an important percentage of the total cost of serving the majority of electric light customers is the multiple rate system. Under such a system the customer is charged a certain rate for a certain number of hours' use per month of his full connected load or of his maximum demand. Additional energy is billed at diminished rates, the rate depending on the number of hours' use of the connected load. This system in its simplest form has only two rates and hence is commonly known as the two-rate system. Many companies, however, use more than two rates. For the sake of simplicity the two-rate system will be taken up first.

To take a specific example, one company using this system (the Cleveland Electric Illuminating Company) charges 12½ cents per kw-hour until the customer's kw-hour consumption has reached a point equivalent to 40 hours' use per month of all the lamps connected. For all energy over and above this amount the rate is 5 cents per kw-hour. For example, take the case of a customer who has 20 50-watt lamps or a connected load of 1 kilowatt and his kw-hour consumption for one month is 78, he would be billed as follows:

To 40 kw-hours at 12½ cents per kw-hour	$5.00
To 38 kw-hours at 5 cents	1.90
Total	$6.90

It is thus seen that this rate arrives at a somewhat similar result to the readiness-to-serve rate, but by a different route. The customer is not charged anything for readiness-to-serve under that name except possibly in some cases $1 a month minimum bill; but in order to take care of fixed charges he is charged the high rate up to a point where the amount of his bill approximately covers his fixed or readiness-to-serve charges. These being paid on the high-rate portion of his bill, he gets his additional energy on the low-rate portion at a very low figure. Great variations are found in the rates charged under the two-rate system by various companies. Some companies make a great step from the high-rate to the low-rate portion. Other companies make but a small step. Besides the variations in the price per kw-hour charged on the high and low-rate portions by various companies, there is considerable difference in the number of kw-hours' use of the connected load which is required before the low rate begins to apply. Few, if any, companies begin to apply the lower rate until 30 hours' use has been made of what is counted as the connected load. Some companies require 60 hours' use of the connected load before the low-rate begins to apply. There is evidently an infinite number of combinations that can be made in adopting a two-rate system. Multiple systems employing more than two rates are worked on the same principle as the two-rate system. For example, one company, the Union Electric Light & Power Company, of St. Louis, has a multiple rate system employing four rates as follows: For energy up to 2 kw-hours per month per 16-cp lamp connected, 12 cents per kw-hour; for energy over 2 kw-hours and less than 4 kw-hours per 16-cp lamp connected per month, 10 cents per kw-hour; over 4 kw-hours per 16-cp lamp connected per month up to 8 kw-hours, 7 cents per kw-hour; all in excess of 8 kw-hours per month, 4 cents. In applying a multiple rate system, as in applying the readiness-to-serve system, allowance must be made for residence and other customers which do not have the full connected load turned on usually during the winter peak load on the central station. One company which has a two-rate system figures the connected load only 40 per cent of the actual in residences. It is sometimes figured that only certain lamps, such as those in the living room, dining room and kitchen will be on during the peak and these lamps are counted together with a small allowance for those in other rooms in the house.

MAXIMUM-DEMAND METER SYSTEM.

So far systems have been considered where the connected load has been used as the basis upon which to figure fixed charges, or, if the full connected load is not taken, certain assumptions have to be made as to what percentage of the full connected load would be turned on during the winter peak load period at the central station. These systems where such assumptions must be made are evidently open to criticism because it does not necessarily follow that the assumptions made are correct as to what the customer's actual maximum demand during the peak will be. This is not, however, a matter of great importance because in the great majority of cases assumptions as to maximum demand are very nearly correct. The plan of estimating the maximum demand rather than actually measuring it, however, has this drawback, both from a central-station company's and customer's point of view. If readiness-to-serve charges or if rates under a multiple rate system are dependent on the number of lamps connected, it is likely to have the practical effect of making a customer keep down the number of lamps connected to the lowest possible amount. In residences it is very desirable that the customer should have a large number of lamps in order to have them whenever they are needed for convenience. If he has these lamps it is a certainty that his consumption of energy will be greater than if he does not have them, although they will make very little difference on his maximum demand. This restriction on the number of lamps wired in residences will have a detrimental effect on the company's revenue.

It must be admitted that it is a point against the system, in that it puts a penalty on a large number of connected lamps in a residence. In the case of a merchant who wires his building for a lot of display lighting which is turned on only a few hours a year and that during the winter peak period, the method of charging according to connected load has a very beneficial effect in putting a stop to such practice. In the case of a residence, where convenience is the strongest argument for electric light, a system which puts a penalty on maximum convenience is not altogether desirable.

In order to overcome objections of this kind which apply both in lighting and power work, the maximum-demand meter has been made use of by some companies. The maximum-demand meter is installed along with the watt-hour meter at each customer's premises. The Wright demand-meter (which is practically the only one used) works by the action of heat on a liquid, which, with a given current, will rise to a given point in a tube. The maximum height to which the liquid in the tube has risen during a month is indicated and gives to the meter-reader each month the customer's maximum demand during the month. The meter-reader turns the instrument back to zero each month. Bills are then figured as in the example given under the two-rate system, except that the maximum demand as indicated by the demand-meter is taken as a basis from which to figure instead of the connected number of lamps. Thus, in the example given, 40 hours' use of the actual indicated maximum demand would be figured at 12½ cents per kw-hour, and the balance at 5 cents. If the maximum-demand were, for example, 0.8 kilowatts, then 40 hours' use of 0.8 kilowatts would be 32 kw-hours and the bill would read:

32 kw-hours at 12½ cents	$4.00
46 kw-hours at 5 cents	2.30
Total	$6.30

The introduction of the Wright demand-meter was due to Mr. Arthur Wright, before referred to, who in 1897 presented a paper before the National Electric Light Association in this country on the system employing this adjunct. Maximum-demand meters have not been used more extensively in this country, mainly on account of the expense of supplying these meters to a large number of small customers; the cost of the demand meter, for example, in the case of a small customer being about two-thirds or more than that of the watt-hour meter.

EXAMPLES OF RECENT RATE SYSTEMS.

In order that the reader may have before him some examples of recent rate systems in which the foregoing principles have been applied, a number of typical examples have been selected from central stations of the United States and their rates are given in what follows in order to place before the reader in convenient form information which has heretofore been scattered through our files.

The Denver Gas & Electric Company, which was the first to adopt the Doherty readiness-to-serve rate system, gives its customers the option between the readiness-to-serve rate that was previously mentioned and a straight meter rate of 10 cents per kw-hour for all energy used, provided the minimum bill is not less than $1.50 or less than 5 cents per month per socket connected. The readiness-to-serve contract calls for $1 per month per consumer plus 15 cents per month per 16-cp lamp connected plus 5 cents per kw-hour for all energy used. Power customers are given a choice on the one hand between a bill of 4 cents per kw-hour with a minimum bill of $1.50 per month or $1 per horse-power connected, or on the other hand, a readiness-to-serve contract under which there is $1 per month service charge plus $2 per month per connected horse-power plus 3 cents per kw-hour for all energy used. All these rates are subject to a 10 per cent discount for prompt payment.

At Madison, Wis., a readiness-to-serve lighting rate is in force, except that 6 cents per kw-hour is charged for energy. Similar systems are in vogue at Lincoln, Neb., San Antonio, Tex., St. Paul, Minn., and Beloit, Wis. In these places, however, the contract is optional and is not applied in the residence district except at Lincoln, Neb.

The Cleveland Electric Illuminating Company is a good example of a company using the two-rate system. Its rates have already been mentioned in the example given as to the application of the two-rate system.

At Gallipolis, Ohio, under the pressure of natural gas competition, the company adopted a two-rate system, charging 12 cents per kw-hour for the equivalent of 30 hours' use per month of any installation and 3½ cents per kw-hour for all energy in excess of that.

At Detroit one form of residence-lighting contract is on a two-rate system at 16 cents per kw-hour for the first two kw-hours' use per month per room and 4 cents for all energy used beyond that, subject to a 10 per cent discount.

Among the multiple-rate systems is that of the Union Electric Light & Power Company, of St. Louis, whose rates were given previously in this article as an example of the multiple-rate system.

The Union Gas & Electric Company, of Cleveland, Ohio, has a multiple-rate system in which the discounts are dependent on the number of hours' use per month of the full connected number of lamps in lighting service, although in power service the discount is purely according to quantity. The lighting service discounts are as follows:

On a consumption per 16 cp. incandescent lamp or equivalent connected, in one month.....				
	2,000 to	3,000	watt-hours,	5 per cent
	3,000 to	4,000	" "	10 per cent
	4,000 to	5,000	" "	15 per cent
	5,000 to	6,000	" "	20 per cent
	6,000 to	7,000	" "	25 per cent
	7,000 to	8,000	" "	30 per cent
	8,000 to	9,000	" "	35 per cent
	9,000 to	10,000	" "	40 per cent
	10,000 to	15,000	" "	45 per cent
	Over 15,000		" "	50 per cent

The New Bremen, Ohio, Electric Light Company uses a multiple-rate system which is graded by small steps over a wide range, beginning at 20 cents and ending at 3 cents, as shown in the table in the next column.

Next come the multiple rates in which the maximum demand is determined by either a maximum-demand meter or by occasional tests by the central-station company with indicating meters.

The Chicago central-station companies have a lighting rate of 14 cents per kw-hour for energy used up to and including 30 hours' use per month of the maximum demand as indicated by the maximum demand meter and 9 cents per kw-hour for energy over that. This is a two-rate system. For power a three-rate system is now in force. A service charge of 50 cents per horse-power connected is made. For a consumption equivalent to the first 30 hours' use per month of the maximum demand the rate is 10 cents per kw-hour. For that portion over 30 hours and less than 60 hours' equivalent use of the maximum demand, 5 cents. For all in excess of a metered consumption equivalent to 60 hours' use, 3 cents.

	Per Kw-hr. Cents.
All load connected used ¼ hour per day average	20
Excess to ½ hour	10
All load connected used ½ hour per day average	15
Excess to 1 hour	9
All load connected used 1 hour per day average	12
Excess to 2 hours	6
All load connected used 2 hours per day average	9
Excess to 3 hours	3¾
All load connected used 3 hours per day average	7¼
Excess to 4 hours	3¼
All load connected used 4 hours per day average	6¼
Excess to 5 hours	2½
All load connected used 5 hours per day average	5½
Excess to 6 hours	1½
All load connected used 6 hours per day average	4¾
Excess to 7 hours	1¼
All load connected used 7 hours per day average	4¼
Excess to 8 hours	1¼
All load connected used 8 hours per day average	3⅞
Excess to 9 hours	1¼
All load connected used 9 hours per day average	3⅞
Excess to 10 hours	1¼
All load connected used 10 hours per day average	3⅝
Excess to total	3

In Detroit one form of lighting contract calls for 16 cents per kw-hour of the first 30 hours' use of the maximum demand as measured by a demand-meter plus 4 cents per kw-hour for all energy used in excess of that. The power contract for large consumers furnishes an example of the application of the readiness-to-serve system to a maximum-demand contract. Under this contract the customer is charged $4.50 per month per kw of demand plus 1 cent per kw for energy used. If the customer will make a non-peak contract whereby he is shut off during the peak load period, this readiness-to-serve charge is reduced from $4.50 to $3.00 per month per kw of demand.

The central station at Boston has many different forms of contracts and it will be impossible to give all of the rates here, but two general forms of contracts are in force. One plan is to charge according to a two-rate system in which the customer pays the full rate of 15 cents per kw-hour for a certain amount each month, this amount being determined by the number of hours' use of the maximum demand; a lower rate being given for all over this amount. The peculiarity of the Boston system, however, is that the number of hours' use per month of the maximum demand at the full rate is different for the various months of the year, being 60 hours in January and December and gradually coming down to 30 hours in June and July. The secondary rate is 12 cents per kw-hour which obtains after the specified number of hours' use of the maximum demand per month. Under another form of contract the customer pays $5 per month per kilowatt of demand plus 5 cents per kw-hour. The demand is determined by the maximum-demand indicator, except in installations of less than 1 kilowatt where 1 kilowatt is considered the demand. In the first form of contract mentioned the maximum demand is taken as the greatest reading of the indicator during any month. Under the readiness-to-serve contract which calls for $5 per month, the contract is made by the year only, and the maximum demand is taken as the greatest reading of the indicator between Nov. 1 and Feb. 1; or, in other words, the winter peak period.

FLAT-RATE SERVICE.

Since this article is devoted to modern-rate systems, no consideration has been given to the old-fashioned flat-rate whereby the customer is given unlimited service at a certain price per month per lamp connected. The flat-rate system for the majority of customers is now generally considered to be entirely out of date. There are cases, however, in small towns, where a customer has only a few lamps (for example, less than five) and the company can better afford to make a flat rate than to buy and maintain a meter, provided the flat rate is high enough.

There is another class of business for which it is now considered good practice to adopt a flat rate. This is show-window, sign and display lighting which is taken under a contract that it is to burn a certain number of hours each night. In this case, since the company has absolute control over the turning on and off of lamps, the amount of energy used can be calculated in advance. It is customary to charge at the same rate for such sign and display lighting as the customer's bill would amount to if he used his sign and display lighting the same number of hours on a meter under a readiness-to-serve contract. The decided advantage of taking this business under a flat-rate contract is that if the customer has his signs, windows and outline or display lighting on a meter, he is likely to economize by turning them off many nights; whereas if they were on a flat rate, they would be kept burning every night.

ELECTRIC HEATING RATES.

The question of electric heating rates is now prominently in the minds of many managers. While the same general principles should govern the making of electric heating rates that govern all other rates, as previously set forth in this article. it may be well to point out some of the peculiarities of electric heating load which should be considered in making rates for it. The electric flatiron can be operated with reasonable economy, off the regular lighting circuit meter at lighting rates.

If any considerable amount of electric cooking is done, however, it has been quite generally accepted that but little progress can be made unless a rate the equivalent of 5 or 6 cents per kw-hour is made on this class of business. Whether such a rate can be profitable to the central station or not depends on how much of the electric heating and cooking load comes on the winter peak on the central station. If it were steady peak business like lighting, certainly no company could afford to take it at a rate which would net only 5 cents per kw-hour. However, it is not by any means peak-load business, especially in the smaller cities, where the principal meal is at noon. There are not sufficient data in existence at present to enable one to analyze very closely the average character of electric heating and cooking load to determine how much of the fixed charges of a central station and distributing system it should be made to pay. On this data are being collected for future publication. Some companies have gone ahead on the assumption that it is a load at least as good as the ordinary motor load (which is probably true) and make ordinary motor rates in the neighborhood of 5 cents per kw-hour. In such cases it is necessary, of course, to install a separate meter. Where a multiple rate system is in use it is a very simple matter to connect heating apparatus to the same meter and put it in the regular lighting bill and at the same time give it the low rate that it must have. This can be done by not counting the heating apparatus as connected load when figuring the customer's bill. As the customer's lighting bill is nearly always large enough so that part of it is figured on the lower or secondary rate, it follows that all of the additional energy consumption caused by the heating devices will come in at the low rate. For example, if the rate is 12½ cents for the first 40 hours' use of the connected and counted number of lamps and 5 cents for all over that, the lighting will nearly always be in excess of the equivalent of 40 hours' use of the counted and connected lamps, thus giving the customer all of his heating and cooking energy at 5 cents. In cases where a two or three-rate system is used with the maximum-demand meter, the same thing can be accomplished by taking off the heating circuit leads before the maximum-demand meter is reached, so that the demand meter registers only the maximum demand on the lighting circuit. It may be argued that these methods of not counting the heating circuit load in the maximum demand are simply methods to dodge the issue. No doubt, some of this heating and cooking business should be counted as coming on the peak, but from the data so far available it does not seem likely that a very large percentage of the total connected capacity of heating apparatus should be so counted.

Methods of Computing Central Station Rates in Boston.

The Edison Electric Illuminating Company of Boston has recently made public its general method of computing rates, in connection with an inquiry by the Public Franchise League of that city. A detailed explanation of the theory on which rates are based was given, the general summing up of the question being the point that the costs of an electric lighting company are actually the sum of what its customers' costs would be, if they supplied themselves under the different conditions under which they consume energy, less such deduction as is justified by the use of the same plant by different customers, and such deduction as is justified by the greater economy of the company's larger plant.

The rate originally established under the demand system and first offered to the company's customers in 1898 was what is now called the "Yearly Lighting Rate." This rate first consisted of a primary charge of 1 cent per lamp-hour, or 20.2 cents per kw-hour, and a secondary charge of 0.4 cents per lamp-hour or 8 cents per kw-hour. In 1898 the so-called fixed costs of the company were rent, station repairs, steam repairs, electrical repairs, meter wages, line repairs, meter and lamp repairs, directors' fees, officers' salaries, general salaries, rent of offices, general office expenses, taxes, insurance, legal expenses, bad debts, incidentals, maintenance, interest and dividends. These totalled $690,872.64. The so-called running costs were coal, oil and waste, water, station wages, carbons and incandescent lamps, amounting to $179,395.24. The station maximum during that year was 4,654 kw, or an average fixed cost per kw of station demand of $148, or an average fixed cost of $99 per kw of customers' demand.

As a result of the company's efforts to get at the truth of the rate problem, it was finally realized that while the fixed costs were undoubtedly correct, they were, after all, only average costs, and that as average costs they were made up of individual costs both higher and lower than the average. The higher costs ran to the small customers. While it was not considered necessary or practicable to raise the small customers' charges on this account, it was felt that a systematic method must be adopted by means of which the larger customers should be relieved of the excess costs occasioned by the smaller customers, as nearly as possible in proportion to their increased size. The average wholesale discount amounts to practically 20 per cent, ranging from 0 to a maximum of about 50 per cent. The different stages were each verified by figuring the cost to the company of supplying hypothetical cases from medium to the largest size likely to be supplied, and the wholesale discounts were decided upon only after making sure that at no point would they be too low under the conditions met at that point to cover, not only the actual costs to the company, but also an increment which would go toward helping out the smaller customers. That the experience was not confined to hypothetical cases is shown by the fact that the closing down of the company's old first and second stations was only done after the management was satisfied that the energy hitherto supplied by them could be furnished cheaper by the South Boston plant than these stations could be maintained and operated for.

The company figured that the increased investment in the system of distribution alone necessary to supply a large number of small customers in place of a few large customers would justify an average wholesale reduction of from 20 to 25 per cent. It is probably not generally realized that 25 per cent of the gross income must be necessitated by the 50 per cent of the plant which consists of the system of distribution. In addition there are a large number of minor expenses incurred on account of the small customers alone.

In 1901 it was decided that there were a large number of customers whose use was too short to warrant their signing a yearly lighting contract, but who considered themselves entitled to some reduction in prices, owing to their using during some months of the year of a large amount of energy. Many

of these were winter customers only, and it became desirable to treat these customers as a class. As they used the service very irregularly it was realized that instead of basing the maximum demand upon the actual winter reading, if it were possible the reading of the indicator each month should be taken as the basis of that month's bills. Provided one of these customers used energy every month of the year, as the demand in summer is less than the demand in winter, the adoption of this method meant that the demands actually taken would amount to the same as using the average maximum for the year instead of the actual winter reading, which average would be considerably less than the actual maximum. This average was estimated from the company's experience to be about 75 per cent of the winter maximum, not considering the customers who have no summer lighting. It was thought that an increase of 10 hours per month or 120 hours per year, at primary rate (an increase of 30 per cent in hours) would almost compensate for the use of the average maximum, and 520 hours was therefore adopted for this class instead of 400 hours in the contract class.

The customer is not obliged to pay for 520 hours at the primary rate, but in order to get the secondary rate, is only obliged to pay for the number of hours apportioned to any particular month, after which any excess current used in that particular month is billed at the secondary rate. Though this class did not guarantee the payment of their primary units, each month was to be settled on its own basis, and only actual consumption was to be billed, though the demand multiplied by the hours in any given month might call for a larger amount.

The secondary rate was therefore made 12 cents per kw-hour to offset shortages in this class and which did not occur in the yearly lighting class; and also because these customers were then getting a rate of 20.2 cents less 10 per cent discount, making their net rate about 18.2 cents, so that the primary rate for this class has to be made lower than the primary rate for the contract class. Both of these facts meant that the company would get an income from the primary much less than sufficient to cover the fixed costs, and it was expected that the increased income from the secondary rate would help diminish this deficit.

It was not until 1905, after getting the demand system fully applied to the lighting business, that the company felt it had been sufficiently tested, both from the consumers' as well as the company's standpoint, to warrant the adoption of a power rate based upon the foregoing principles. Actually, the power price-list which has been in use for many years was based upon the demand system. The power rate had been 10 cents per hp-hour, with discounts depending, not only upon the size of the bills, but upon the size of the customer's motor. A change in method rather than rates was intended.

The amount of fixed costs per kw customer's demand was about $37, on the 1898 basis, which is properly chargeable to an average power customer, the smaller customers running above this and the larger ones below. A primary rate of 18 cents per kw-hour for 15 hours' monthly use was first adopted and used until the lighting rate was reduced to 15 cents, when for the sake of uniformity the primary power rate was turned to 15 cents per kw-hour for 18 hours' use, which was a slight reduction over the previous rate.

On account of the uniformity of the power business as between summer and winter, it was not considered correct to make a sliding scale of hours to be charged at primary rate for this business, and the primary unit guarantee was soon cut out.

At the present primary rate figures, the annual income from this source per kw customer's demand is about $32 (15 cents x 18 hours x 12 months), and the secondary rate was made 9 cents per kw-hour, partly in order to offset the shortage in fixed costs. The power business was felt to be subject to the same wholesale and retail laws as the lighting business, but on account of the increased secondary rate over that of the yearly lighting rate, which about this time (1905) was reduced to 5 cents, it was necessary to commence these discounts on smaller gross bills than in the lighting business.

It was decided that inasmuch as elevator service represented a type of power use particularly intermittently with consequent high diversity factor (ratio of the sum of the customers' demands to the actual station demand), several elevators could be supplied to one customer at a much lower cost than the same energy could be sold for ordinary power use. The demand indicator could not be satisfactorily used to register the total starting current of the elevator. There appeared to be no elevators in use which did not require a starting power of at least 10 kw, and while this might occur very frequently, the demand was of too short duration to record properly on the indicator. The elevator rate at present in use was therefore adopted as the one best meeting the conditions. The elevator rate varies from 6 cents to 2.5 cents per kw-hour by four deductions according to the energy consumption, the lowest price applying to the consumption in excess of 4000 kw-hours per month.

The street lighting business is of such a character that the plant required by it is not used by other customers, with consequent high fixed costs per kw of demand. The price was made $15 per year for each 87.5-watt incandescent lamp. This is equivalent to about 11.4 lamps per kw, which, multiplied by the price of $15 per lamp, would give a gross income per kw of about $171, which, however, includes 1600 hours' burning. With a secondary rate of 0.4 cent per lamp, which is the figure used to adjust the price when more or less than 1600 hours are required, the secondary rate per kw-hour becomes a little over 4.5 cents. Deducting the 1600 hours' burning at this rate from $171 would give an income on account of the fixed costs of $98, with the secondary rate of 4.5 cents, or apparently less than should be charged at the primary, which shortage is made up by the increased secondary.

On July 1, 1906, the Boston Edison Company made a further reduction in prices. This was warranted by the decreased fixed running costs. The station maximum in December, 1905, was 26,311 kw; dividing this into the fixed costs ($3,031,319.87) gives a fixed cost per kw station demand of about $115, as compared with $148 in 1898. The kw-hours sold for the same year were 50,051,716, which, divided into the running costs of $539,742.89, gives a running cost per kw-hour of about 1¼ cents as compared with 2 cents in 1898. If an exact division of these two classes of expenditures could be made, it would result in a slightly increased fixed cost and a slightly diminished running cost. The company has therefore assumed that a fixed cost per kw station demand of $120, and a running cost of 1 cent per kw-hour would be as nearly accurate as could be figured. With the diversity factor of 1.5, this would make a fixed cost per kw customer's demand of $80, which is merely an average, the smaller customers running much above it and the larger ones much below it.

The introduction of the demand system for the non-contract customers had resulted in a considerable saving to a large number of this class, but there was still a much larger number of such customers whose burning was so short that no reasonable differential rate plan would be of use to them in reducing their bills, the only effective method being a reduction in the primary rate, though such a method implied an additional loss on this business. This class was numerically so great, however, that it was decided that the reduction warranted by decreased costs should be shared by these customers. The primary of the lighting rate was therefore reduced from 18.2 cents to 15 cents per kw-hour. At the same time the reduction of fixed and running costs demanded that the retail yearly lighting customers, who were the people really entitled to it, should also share in the benefits, and to accomplish this the secondary of the yearly lighting rate was reduced from 8 cents to 5 cents per kw-hour.

In regard to the maximum and minimum saving per kw-hour on electricity sold under wholesale discounts, short-hour customers pay as a maximum 15 cents per kw-hour. The maximum possible saving to such customers under the wholesale discount would be just under 50 per cent, or a theoretical rate of between 7.5 and 8 cents per kw-hour. As the length of use

increases, the rate decreases, and long-hour customers, however small (down to 0.1 kw or 2 lamps) can obtain a rate as low as 5⅜ cents for 25 hours' use. A number of very small customers do in practice reach a rate under 7 cents. Customers who obtain both the wholesale and long-hour discounts can theoretically reach a rate of between 2 and 3 cents. Some long-hour lighting customers actually reach a rate of about 3¾ cents, and some long-hour power customers 2.5 cents, but the average rate that wholesale customers reach is only about 20 per cent better than small customers of equally long use.

Illuminating Engineering in Central Station Work.

Among the papers submitted in the prize competition of the Co-operative Electrical Development Association was an excellent one by Mr. W. W. Edwards, of the Edison Sioux Electric Company, Sault Ste. Marie, Mich., which in the award of prizes was probably considered as ineligible owing to the treatment not being narrowed to the specific details of a "new business" department. An abstract of this paper is printed below.

A good deal of attention has always been given to the tracing and stopping of central station losses, but these investigations have seldom been pursued beyond the consumer's meter, thus stopping at the very point where they should have been continued. It is becoming more apparent every day that some of the most important losses in central station lighting service are to be found in the customer's installation, in the selection and arrangement of lamps and the form and nature of globes and reflectors employed. The consumer at this critical stage is commonly left to his own devices. It is needless to say that the average customer understands little of the principles governing interior illumination either for residence or commercial purposes, hence the result can easily be imagined.

One cause of dissatisfaction and decreased earnings is found in the fact that the ordinary incandescent lamp is allowed to remain on the circuit long after it has become dim and blackened, and very often until burned out. This is not only a fruitful source of complaint, but the decrease in the conductivity of the lamp constitutes in the aggregate no small loss to the lighting company.

There is no branch of central station service where the need of expert advice and supervision is greater than in the field of lighting, nor is there another where the returns are greater or more certain. Some of the complex situations encountered in this division of the lighting service will require considerable study and comparison in order to obtain the best results; hence the necessity, not only for persistent investigation but also for a keen observation of the different effects in lighting.

As to equipment, a good photometer is a prime necessity. This should be mounted on a suitable carriage and equipped with a full supply of screens, also an attachment for studying reflected light. The latter will be found very valuable, as reflected rays constitute an important part of lighting; the irregular or diffused light being highly desirable for residence illumination. A simple device for studying reflected light is in the form of a large box lined with black cloth, and entirely enclosed except an opening for observation of the interior and a much narrower one for the admission of artificial light. Through this narrow opening a direct ray of light is thrown upon a small reflector, the light being reflected upon any desired surface placed on the opposite side of the interior. By placing samples of wall paper instead of the reflector, the comparative reflecting properties of different shades and qualities of paper may readily be ascertained; however, this is only a suggestion, but a dark room of some kind is very necessary in this work.

In addition to the photometer, an indicating wattmeter will be necessary or at least very desirable in measuring the load of the different installations. A reliable voltmeter will also be convenient. Each workman in this department shall possess a set of hand tools such as are used for interior wiring. The department should be supplied with samples of all globes and reflectors in common use, to be employed in making experimental tests.

Besides the above named equipment, the department itself will invent many devices to aid in the successful conduct of its work. Most of these, as well as the photometer, will be used mainly in testing and making comparisons; a kind of laboratory practice the results of which will be used in actual practice, where the different lighting effects are noted almost entirely by the eye.

There are at least two prime essentials for good service from incandescent lamps. First, there must be central station control of the lamp supply and renewals in order that the proper efficiency, size and type of lamps may be intelligently selected and used, and that dim and blackened and burned-out lamps may be properly removed from the circuits. Second, there should be a periodical overhauling of lamps in circuit, inserting new lamps in place of those which have passed the period of their useful life.

First in order is the work of installation as applied to residence and commercial illumination. When an application is made for electric lighting, the interior wiring of the building usually having been done by contractors, an installation order is made in several copies at the office by means of carbons, a copy being sent each department having work to do on the installation.

The service department at once runs service lines to the building, or merely connects them as the case may be, while at the same time a man from the illuminating engineering department makes an inspection of the premises, and assists the customer in the selection of lamps, reflectors, etc., best suited to the purposes for which each is to be used. Every detail necessary for the satisfactory lighting of the premises is considered before leaving, the quality as well as the quantity of the light receiving attention. The customer is thus given to understand from the beginning that the company understands its business and is determined to insure for him the very best results possible. Too much stress cannot be placed upon the importance of establishing and maintaining this favorable impression on the part of the customer.

Improvement in existing lighting service is the next step. Naturally, any complaints regarding unsatisfactory lighting service will receive first attention. Uniformity and promptness of action are secured by means of an operation order which, like the installation order, is issued from the office and is made in more than one copy if the attention of other departments is desired.

Whatever difficulty, it is located and remedied, even though it involves radical methods and some expenditure. Complaints have always existed in a greater or less degree, but it is hoped and confidently expected that with the advent of the illuminating engineering department this class of complaints will entirely disappear.

In this connection, it may be well to mention two existing difficulties which will cause the new department no little annoyance. One is the tendency on the part of those doing interior wiring to allow for only a limited number of outlets or not to distribute them properly, regardless of the fact that as much depends upon the efficient use of a lamp as upon the efficiency of the lamp itself. The other difficulty lies in the color and quality of wall and ceiling paper and the shade of interior finish. Many customers will select sombre green or other dark color, apparently ignorant of the fact that this shade of paper is a powerful absorbent of light and will not reflect more than 12 per cent to 20 per cent of the light thrown upon it. While this results in an increased use of energy, the gain is more than offset by the annoying complaints of the customer and the misleading reports which he will circulate in regard to the cost of electric lighting.

The opportunities for improvement in lighting efficiency are many, but in most cases the obstructing ideas or existing carelessness must be located by persistent search. The adjustment of a few complaints is only a beginning. The real aim of this department can be accomplished only by a systematic examina-

tion of the premises of every customer on the circuits. In some instances, quite extensive alterations may be necessary, but a satisfied customer is a good customer to have. In order to demonstrate the advantages of making certain changes, it may often be desirable to temporarily install a different kind or size of lamps, with suitable reflectors if necessary, the customer signing a temporary installation receipt therefor. The consumer is at all times given the benefit of valuable advice regarding illumination, and will soon learn to consult this department before making any change in his lighting installation.

The improvement of street lighting will usually require only limited attention after the first year unless some general change is made in the style of arc lamps or in the character of globes and reflectors employed, such as to necessitate a different elevation of the lamps in order to obtain the best service therefrom. In case a narrow street renders any change necessary in the height of the lamps, or the proximity of a dark alley makes a different kind of a globe or reflector desirable on an individual lamp, the new department will report the same to the office with particulars. A regular operating order will then be issued to the department having charge of this work.

Great diversity of opinion exists in regard to the proper stage at which it is profitable to remove the incandescent lamp from the circuit. Many central station companies in the smaller cities make no attempt whatever in this direction, except to furnish free renewals as an inducement to customers to return lamps when burned out.

In every well-conducted electric lighting business, the renewals of incandescent lamps are carefully recorded and form one branch of distributing expense; hence the manager knows the monthly expenditure for this purpose, often regarding the same as a direct loss. Though not strictly a part of the subject of this paper, a few reasons are here given for the following plan of renewing lamps.

The useful life of a 3.1-watt lamp at normal voltage is estimated by good authority to be 400 hours to 450 hours, the 3.5-watt lamp about 800 hours; at which time the candle-power has fallen to about 80 per cent of rated value. Practical test demonstrates the fact that a lamp which has passed the above period will not conduct as much current as before, the difference increasing with every hour the lamp remains in service.

It is true that the lamp will require more current per candle-power of light delivered, because the candle-power decreases faster than the consumption of current, caused in part by the deposit of carbon on the inner surface of the glass bulb causing it to become blackened. On the other hand the total amount of current passing through this lamp in a given time will be less than in the case of a new lamp, chiefly because of loss of conductivity in the carbon-treated filament of the old lamp. It is safe to say that thousands of dollars are wasted annually by lack of attention to this important principle, enough to repay many times the extra cost of renewals.

The habit of allowing lamps to remain on the circuit after passing the period of their useful life is therefore not only an injustice to the customer by reason of decreased candle-power, but a direct reduction in the earnings of the lighting company. For these two reasons it is imperative that a systematic renewal of lamps be made at stated intervals, these being more frequent during the winter months. Any desired conveyance may be used for this purpose, from a one-horse wagon to an automobile. A record-book containing a record of the number and candle-power of lamps, both delivered and returned, is signed by the customer. In this way the accounting department may not only compute the cost of renewals, but also note any slight changes of candle-power in the customer's installation. Lamps are obtained from the store room upon requisition, the same as other supplies. Thus the brilliancy of the incandescent lighting service is maintained unimpaired, resulting in the satisfaction of the customer and in a substantial increase in the earnings of the lighting company.

Whatever may be the means employed, the engineering of illumination demands and must have prompt attention if electric energy is to hold its own in the field of modern lighting.

The Southwestern Electric & Gas Association Convention.

The third annual convention of the Southwestern Electric & Gas Association was held at San Antonio, Tex., at the Menger Hotel, May 14, 15 and 16. The convention was a most successful one from every standpoint. All the meetings were well attended, the papers presented were well prepared and the distribution of printed copies before their presentation had an effect in promoting discussions concerning them. Each member was provided with a bound copy of the question box, the questions and the answers to them, submitted during the year having been edited and put in book form by Mr. Samuel Kahn, of the San Antonio Gas & Electric Company. Selected subjects from this question box proved sources of very beneficial discussions.

The first session was called to order Tuesday morning by President H. S. Cooper, of Galveston. He introduced Mr. Regan Houston, of San Antonio, who in welcoming the convention made some appropriate remarks concerning the recent legislation against corporations in Texas.

President Cooper confined his address largely to emphasizing the importance of united action on the part of the lighting and electric corporations of Texas to prevent unjust legislation against them in the future. He urged that a permanent secretary's office be established in order to better carry on the work of the legislative committee, saying that if it had not been for the ardent work of the committee the legislature would no doubt have taxed the corporations 2 per cent of the gross receipts instead of ½ and ¾ of one per cent. At the request of President Cooper, Mr. H. T. Edgar, of Fort Worth, told of the work of the legislative committee and explained the conditions under which it worked.

The first paper presented was that by Mr. H. M. Moore, of San Antonio, on the education of legislators with reference to public service corporations. Mr. Moore said he believed most representatives desired to deal fairly with all concerned. As a whole it was those who made the legislators that needed attention and good service would tend to inspire good service. He emphasized the necessity of the legislative committees being supplied with definite data regarding plants and suggested a committee on statistics to get this data.

Tuesday afternoon Mr. V. W. Berry, master mechanic of the Stone and Webster electric railway properties in Texas, read a paper on the use of labor saving devices in central stations and car barns. He said that many large electric power plants had been equipped with cranes and hoists for handling machinery or parts when necessary to make repairs or when new machinery was being installed; yet in some of these plants little attention had been given to machinery and equipment for handling coal and ashes. The discussion on Mr. Berry's paper was largely concerned with apparatus for the street railway repair shop.

An animated discussion concerning the keeping of pole line data was aroused by one of the subjects of the question box.

Mr. F. C. Randall, of Galveston, explained a method of keeping such data recently adopted at Galveston. Perspective views of sections of the pole lines were drawn on cards. The drawings were all made so that the observer faced the pole line going away from the station. In the drawings all the wires and attachments on the poles were shown. Blue lines indicated primary wires, red lines secondary circuits and green lines railway feeders. Pole locations were numbered consecutively. When lines branched, a separate set of cards was made for each branch.

Mr. W. B. Head, of Grandview, Tex., said he kept data in a large loose-leaf ledger, each sheet of which represented a city block. On these sheets were indicated the location of the poles, the number of electric light and telephone cross arms, and the size of wire. Mr. E. T. Moore, of Dallas, said he had a map of the city on a small scale ruled off into 25 sections and a separate large scale map of each section. The location and

the number of the poles were shown on these maps and each number referred to a card upon which were a description of the pole and minute pole data.

Mr. Samuel Kahn, of San Antonio, said his greatest difficulty was in getting information as to changes and extensions from the linemen. To get this more accurately he provided the linemen with large sheets, ruled with squares representing city blocks. As the lines were put up they were indicated in their proper position by pencil marks. On the backs of the sheets the material used was entered. Mr. E. D. Kelley, of Hillsborough, kept the record for several blocks of a pole line on one sheet. The poles in the diagrams were marked "property side" or "street side" to indicate the relative position of the observer. There was no need of keeping a record of each individual pole when several carried the same lines.

President Cooper did not agree with Mr. Kelley. He thought accurate data should be kept of every pole, saying that when information was kept so that it could be sworn to it might result in much saving in damage suits.

At the conclusion of the discussion on pole line data the subject of treatment of timber with preservatives was taken up. The discussion was started by a query in the question box as to the advisability of treating only the butts of white cedar posts or only a short portion of the pole at the ground line instead of all of the pole. President Cooper said that as lumber had gone up about 100 per cent in Texas in the last few years the question was a pertinent one. He was under the impression, however, that poles could not be creosoted by means of the vacuum process for only a portion of their length. In reply Mr. Edgar said a price of $4.50 had been quoted him for 35-ft. poles with 7-in. tops with only the butts treated. He had been told by pole men that in the treatment the poles were set upright with their butts only in the vacuum cylinder. An air-tight joint was made around the poles where they emerged from the cylinder. He did not think it necessary to treat poles above the ground line, as the untreated portion of the pole would last longer above ground than would the treated portion at the ground line.

Mr. George H. Cushman, of San Antonio, spoke of the property of creosoted poles to conduct current and his remarks brought up the question as to whether the pole became a better or worse conductor with age. President Cooper agreed that creosoted poles were very good conductors. From his experience he did not believe that the conductive properties changed with age, as creosoted poles put up in Galveston after the flood in 1900, and recent new poles, showed no difference in conductivity. In Galveston they were compelled to use creosoted poles because the wet, salty sand in which poles were set rotted out the untreated ones in about two years. The conductivity of treated poles, however, was very objectionable, and linemen always mounted the pole and dismounted it with a jump so as not to have a spur in the pole and a foot on the ground at the same time. His troubles he thought would be greatly lessened if, as Mr. Edgar has stated, a pole with a creosoted butt only could be obtained. One member in asking for information regarding creosoting cypress poles, said a price of $3.25 had been quoted him for a 25-ft. pole. In the discussion regarding the effect of treatment on the wood fibre, it was stated that the deteriorating effect was caused by the high temperature steaming. By seasoning the poles in the air and then submitting them to treatment in vats at no pressure and a temperature of about 200 degrees F. as thorough penetration was obtained as when green timbers were submitted to the vacuum process.

Quite an interesting discussion was had on the subject of new business and how to get it. Mr. Ward, of San Antonio, said that the most profitable business came by working along lines already put up or in following up dead service. San Antonio was divided into four districts. Each district was carded with two classes of cards—commercial and domestic. These cards stated what service a customer had and suggested what service he might be gotten for. Every customer was a "prospect" for additional service. The company had about 200 electric signs in service. Of these more than 90 per cent were on a flat rate with a contract for burning from dusk until 11 o'clock or until 12 o'clock or all night. The signs were turned on and off by the company, two men being employed for this purpose. All interior lighting contracts were made on a meter basis, no flat rates being quoted.

Each morning from 8 to 8:45 o'clock there was a meeting of the solicitors, and every Thursday night there was an electric meeting at which question-box queries were discussed. In response to the solicitation of President Cooper for information from smaller plants, Mr. Stevens, of Midland, Tex., said that his plant started with a 33-ampere load at 220 volts. The blowing up of several gas machines and accidents with oil lamps, together with an earnest solicitation for business had resulted in his 32-kw machine being loaded to its capacity. He had tried the flat rate basis, but as he took load records every half hour he soon found that the rate was abused, and it was changed to the meter basis. He had put out about 20 flatirons, although only night service was given. He would soon start a day service. He charged 20 cents per kilowatt with a sliding discount.

At the opening of the Wednesday morning session a telegram was read from Mr. M. M. Phinney expressing regrets at his enforced absence because of business in the East. President Cooper then appointed a nominating committee of Messrs. H. S. Potter, of El Paso; J. P. Crerar, of Denison; Samuel Kahn, of San Antonio, and E. D. Kelley, of Hillsborough. A special committee for the establishment of a permanent secretary's office was also appointed. This committee consisted of Messrs. H. T. Edgar, of Ft. Worth; W. B. Head, of Grand View; W. B. Tuttle, of San Antonio; A. E. Judge, of Tyler, and C. H. Dunbar, of Houston.

After the appointment of the committees Mr. Arthur C. Scott, professor of electrical engineering in the University of Texas, read a paper entitled "The Value of Scientific Tests to Public Service Corporations." Under a suspension of the rules, Professor Scott was elected an honorary member of the association at the conclusion of the reading of his paper.

Mr. Edgar wanted to know in detail what facilities for making scientific tests the engineering department of the University of Texas had, and in response to Professor Scott told in a few words of the equipment the department possessed and of its needs. In order to draw public attention towards the engineering school and its needs the secretary was instructed to have 500 copies of Professor Scott's paper printed and mailed to members of the legislature.

Mr. F. C. Randall, of Galveston, read a very interesting paper concerning getting up and carrying out forms for keeping data and information in the offices of public service corporations. Such forms he said should show the required data at a glance. They should be simple in wording and the spaces for the information should be arranged so that the information followed in proper sequence and along the trend of thought of the person desiring to use it. Size, shape and color should be given due consideration. The size should be such that no waste be entailed in cutting paper from stock sizes.

In discussing Mr. Randall's paper, President Cooper termed a form a channel of communication of the office with outside business. He emphasized the importance of trying out forms when possible, saying that in nine cases out of ten forms were unfitted for the use to which they were put. In one case that came under his observation men working outside who usually wrote with a stub pencil were supplied with a form having blank spaces measuring 5/32-in. He had adopted a size of 8½ x 11 ins. or multiples or divisions of this size as standards for forms, as such sizes could be cut from stock without waste. Mr. Tuttle said his company had been endeavoring to simplify the forms used by cutting out unnecessary details and avoiding the repetition of information on different forms. Mr. Geo. H. Cushman said that in San Antonio a size of 3 x 5 ins. had been found most convenient for men to carry. President Cooper added that he simplified the filling out of forms by so wording them that the answer "Yes" or "No" often sufficed. He had found

that a circle for "Yes" and a cross for "No" helped matters when the men were not able to write very well.

The Wednesday afternoon session was devoted entirely to the discussion of subjects bearing directly on electric railway operation and the Thursday morning session was given over to the supply men. The object of this latter session was to bring about a closer understanding between the operator and the supply men. Mr. Guy C. Gum, district sales manager of the Nernst Lamp Company, who presided at this meeting, said that supply men were often able to tell managers of properties of mistakes in the operation of their stations, but held back because of a feeling of delicacy in making suggestions. If, however, managers would ask for information the salesmen would feel more at liberty to give them the benefit of their observation at different plants visited.

Mr. O. E. Turner, of the General Electric Company, said supply men should endeavor to bring non-members of the association into line. Other talks were made by Messrs. Ernest Boehme, Electric Service Supplies Company; Sam Hobson, Wesco Supply Company; T. B. Whitted, Westinghouse Machine Company; O. W. Uthoff, Electric Traction Supply Company, and Mr. Bonner, of the Bonner Oil Company. The morning meeting resulted in the passage of a resolution presented by Messrs. T. B. Whitted, U. S. Arnold and O. E. Turner, providing that the supply men who were associate members be provided with lists of members, copies of by-laws, and application blanks to assist them in getting new association members. The resolution also provided that the associate members be supplied with a badge somewhat different from that of the active members and for the appointment of a committee to make arrangements for exhibits at future conventions.

At the opening of the Thursday afternoon session, Mr. D. N. Waplick, of San Antonio, read a paper of interest to gas men.

The report of the secretary showed that the association had a total of 136 members. Of these 67 were active members, 66 associate and 3 honorary.

The establishment of permanent headquarters for the association in Dallas was provided for by the passage of a resolution presented by the committee appointed at a previous session. The resolution stated that the permanent secretary should collect data regarding the rates charged by each member company and the amounts paid under different taxes; that he obtain copies of laws concerning corporations, and that he get other information for the exclusive use of members. After the passage of a resolution thanking Mr. W. B. Tuttle and other officers of the San Antonio Traction Company and the San Antonio Gas & Electric Company for the cordial treatment and entertainment accorded the members and the lady visitors, a second resolution was passed expressing appreciation to Samuel Kahn, editor of the question box, for his work. The question of the place of the next meeting of the association was taken up. H. S. Potter invited the convention to El Paso, and at the executive meeting held afterwards Mr. Potter's invitation was accepted.

The nominating committee reported the following ticket, which was elected: President, H. T. Edgar, of Fort Worth; first vice-president, W. B. Tuttle, San Antonio; second vice-president, J. P. Crerar, Denison; third vice-president, J. D. Oliger, Cleburne; secretary, R. B. Stichter, Dallas; treasurer, A. E. Judge, Tyler.

Executive Committee—H. T. Edgar, H. S. Cooper, W. B. Tuttle, J. D. Oliger, H. M. Moore, J. P. Crerar, R. B. Stichter, M. M. Phinney and J. F. Strickland.

Finance Committee—W. B. Head, C. H. Dunbar and E. T. Moore.

Advisory Committee—J. E. Farnsworth, W. J. Jones, A. A. Hauser, W. H. Chapman, Arthur B. Foster, T. C. Brown, J. A. Myler, A. W. Guthrie, W. Broyles and Fred M. Lege.

President Cooper with some very appropriate remarks gave up the chair to President-elect Edgar, who, after assuring the association of his appreciation of the honor conferred upon him, adjourned the convention.

The Utility of Inventions.

By JOHN E. BRADY.

The laws of the United States provide that patents may issue for any new and useful art, machine, manufacture, etc., under certain conditions, and hence it follows that, in order to be patentable, an invention must, among other attributes, disclose utility. It is not sufficient that an invention be new; it must be useful as well, or it cannot be accorded the protection of the patent laws. By useful invention is meant such a one as may be applied to some beneficial use in society in contradistinction to an invention which is mischievous or injurious to the morals, the health or the good of society. A useless invention, even if patented, is not and never will be of any profit to the public, and the patent granted thereon is void. New inventions in regard to some trifling article of dress, such as "hoops, or crinolines," or, in the language of Judge Story, "a new invention to poison people," are not patentable. The one is frivolous and the other mischievous. Page vs. Perry, 1 Fish. Pat. Cases 298. Utility, as predicated of inventions, means industrial value; the capability of being so applied in practical affairs as to prove advantageous in the ordinary pursuits of life, or to add to the enjoyment of mankind. But a mere curiosity, a scientific process exciting wonder, yet not producing physical results, or any frivolous or trifling article or operation not aiding in the progress nor increasing the possessions of the human race, whatever be its novelty, and whatever skill has been involved in its production, does not fall within the class of useful inventions nor become the subject matter of a patent. Robinson on Patents, Vol. I, p. 463. In Crouch vs. Speer, 1 B. & A. Pat. Cas. 145, it was said that the test whether an invention is useful in the sense of the patent law is not whether it is not mischievous or hurtful, or insignificant, but whether it is capable of use for a purpose from which some advantage can be derived. If it be useful in this sense the degree or extent of its usefulness is altogether immaterial. It is not necessary that it should be the best means of producing a desirable result, but a means, although inferior to others, of producing it.

Inventions which accomplish definite practical results may nevertheless possess such attributes as destroy the benefits that otherwise they would bestow upon the public. Inventions whose chief or only value resides in the facilities which they afford to men to perpetrate some wrongful injury either by fraud or violence upon each other, are thus regarded as destitute of real utility. For the same reason arts or instruments which, if completed and in actual use, might be of benefit to their employers, are sometimes held to be devoid of real utility on account of the great risks incurred in their construction. The courts, in their consideration of this subject, must necessarily contemplate the entire scope and effect of the invention, as well upon the maker and operator as upon the consumer; and if the net result to the community at large is not a benefit, the inventor has no claim upon the public.

The acts of Congress which authorize the grant of patents for designs, were plainly intended to give encouragement to the decorative arts. They contemplate not so much utility as appearance. The law manifestly recognizes that giving certain new and original appearances to a manufactured article may enlarge the demand for it, may enhance its salable value, and may be a meritorious service to the public. It, therefore, proposes to secure for a limited time to the producer of those appearances the advantages flowing from them. Gorham Company vs. White, 14 Wall. (U. S.) 511. Utility is not negatived by the fact that the manufacture covered by the patent has no function except to decorate the object to which it is designed to be attached. In such cases utility resides in beauty. Whatever is beautiful is useful, because beauty gives pleasure, and pleasure is a kind of happiness, and happiness is the ultimate object of the use of all things. Walker on Patents, p. 73. The Westinghouse Electric & Manufacturing Company, being the owner of a design patent (No. 24,416) issued March 22, 1902, to Albert Schmid, brought an action against the Triumph Electric Company, seeking to enjoin the latter from infringing its alleged

rights under the patent. The patent involved covered a design for a configuration of a frame for electrical machines. It was held that the word "useful" in the section regulating the issue of design patents does not require that the shape or configuration of an article, in order to be patentable, shall add some new utility to the article, but is used merely for the purpose of excluding such things as might have a vicious or corrupting tendency, and that a new and original design for an article may be patentable where it merely improves its appearance. But it was further held that, assuming that a frame for an electric machine might be made the subject of a design patent, the frame design in question was not properly patentable for the reason that it was neither new nor original in view of the existing state of the art. The only originality which the counsel for the complainant could reasonably claim for the design patented was found in the curvature of the bases of the pillars for supporting the shaft and of the supports to the cylinder frame for the field; and these were considered differences which would suggest themselves to any workman, and which did not involve the exercise of inventive genius, which is as essential to the validity of a design patent as it is to the validity of a mechanical patent. Westinghouse Electric & Manufacturing Company vs. Triumph Electric Company, 97 Fed. Rep. 99.

It seems that utility is negatived if the function performed by the invention is injurious to the morals, the health or the good order of society. Thus, an invention to improve the art of forgery, or one to facilitate the spread of a contagious disease, or one to render water or air intoxicating would, of course, be unpatentable for want of utility. The more completely such an invention could perform its function the more objectionable it would be in this respect. Walker on Patents, p. 73. In the case of National Automatic Device Company vs. Lloyd, 40 Fed. Rep. 89, the complainant moved for an injunction restraining the infringement of a patent for a "Toy Automatic Race Course." The device covered by the patent consisted of a shaft projecting upward from the center of the base of a circular shell or case, to which shaft a clock-work mechanism was so geared that it could be made to revolve rapidly by releasing the escapement of the clock-work. On the shaft were mounted two or more radial arms, to the ends of which were attached small toy figures of horses. The clock-work was released by dropping a coin through a slot in the machine, whereupon the shaft would revolve, carrying the radial arms with it, for a short time, when the clock-work would be shut off allowing the arms to revolve of their own momentum. The proof showed that the only use to which the device had been put was to install it in saloons and other drinking places, where the frequenters thereof might lay bets as to which toy horse would be the last to stop or would stop nearest a certain designated point; in other words, the machine was used only for gambling purposes. For this reason the machine was held not to be a benefit to society or "useful" within the contemplation of the patent act and the patent was declared void. It was urged that the machine was susceptible of being utilized as a toy or child's plaything, but the fact that no such use of it had been made was considered a sufficient answer to that contention.

Inventions the object of which is to afford amusement and diversion, are classed among patentable subjects; but only the mechanical agencies employed can be patented. Under this rule it was held that the patent of the Paul Boynton Company, covering an inclined gravity railroad terminating in a body of water, which provided an amusement popularly known as "Shooting the Chutes," was invalid, one of the reasons being that, in view of the old art of launching ships, there was no patentable novelty in the combination of an inclined railway located near a body of water and a boat-shaped car or toboggan, adapted to move downward over the railway and to be propelled forwardly upon the water by the momentum derived from its descent. Paul Boynton Company vs. Morris Chute Company, 82 Fed. Rep. 440.

In the Cushman case, 1 McArthur's Pat. Cas. 569, an electrical patent was refused on the ground of the absence of utility and an appeal was taken from the decision of the Commissioner in so refusing. The device for which a patent was sought consisted of an improved method for protecting objects from the effects of lightning by surrounding that part of the lightning rod which is embedded in the earth with a galvanic battery. Its construction and functions were described by the inventor in the following language: "To facilitate the discharge of the electricity from the conductor to the earth is the object of my present invention, and it consists in surrounding that part of the lightning rod embedded in the earth with plates of dissimilar metals, arranged in such manner as to constitute an open galvanic battery. Electromotive power will divide the electricity on the metallic plates and, as they are insulated, they will act as a condenser of the electricity that is opposite to that of the air. Should there be a high electrical tension of the air, by this means the electrical fluid conducted through the rod is more readily discharged by uniting with the opposite electricity as it accumulates on the surface of the plates. When the discharge flows from the earth to the air, then the rod conducts from the plates such electricity as is opposite to that of the air." The reason which the Commissioner gave for refusing a patent was that the intensity of the action arising from either the copper or the zinc plate, or both, in the earth, is thousands of times too small to be sensible as compared with that of a flash of lightning. "The latter has force enough to strike through hundreds or thousands of feet, or sometimes through miles of air. The former has not force enough to strike through the thousandth part of an inch. These are well known facts and the thing must be entirely without practical effect." The court was satisfied that the device in question could be put to no beneficial use and the Commissioner's refusal was affirmed.

The degree of utility is not material and a patent may rightfully issue, so far as that quality is concerned, provided the invention be of some use and benefit. Nor does the simplicity of a device indicate in any way the absence of utility, for this is a recommendation of the usefulness of the article rather than an objection thereto. The existence of utility in an invention is not to be determined by comparing it with other arts and devices, but is rather to be ascertained by an examination of the particular art or device in question. It is not essential to the patentability of a device that it should supersede or be superior to others previously used for the same purpose; nor does the fact that an invention has been displaced by some subsequent invention import a lack of utility. If, however, a patented article rapidly takes the place of all others of similar kind and is successful commercially, these are considerations tending to show that the public welfare has been advanced by its production and that it is characterized by utility within the meaning of the patent laws.

Bending Conduit.

By T. W. Poppe.

There are various ways of bending conduit; but for the smaller sizes there seems to be no better or more convenient means than by the use of a "hickey." A hickey is made of a piece of 1-in. steam pipe about three feet long, and a 1-in. cast iron tee. The tee is screwed on the pipe as shown in Fig. 1.

To bend conduit with the hickey the former is placed on a level floor and the tee on the hickey slipped over it. The stem or handle of the hickey is grasped by the workman who also places one foot on the conduit close to the hickey. The workman then pulls the handle of the hickey towards him. Care should be taken not to keep the hickey in one place on the conduit as a "kink" in the pipe will result. This flattening of the conduit can be avoided by moving the tee of the hickey away from the user, as the bending progresses. The radius of the elbow to be bent can be governed in this way, as a difference in the distance the tee is moved will result in a corresponding larger or smaller bend. To illustrate this more clearly: suppose a workman desires to bend an elbow on a length of conduit, which is to fit into an outlet box on the wall, and that

it is desirable to have one continuous piece of conduit from the ceiling to the outlet box. The distance from the ceiling to the top of the outlet box is 55 inches, and this distance is laid off allowing the starting point to be a partition or a wooden block fastened to the floor. The object of this is to prevent the pipe from slipping away from the mark. The end of the conduit is placed against the partition and the hickey is slipped over the conduit and the end of the tee nearest the workman is placed at a point two inches away from the 55-inch mark or 57 inches away from the end of the conduit. The handle of the hickey is pulled towards the workman until the end of it has traveled

FIG. 1.—HICKEY.

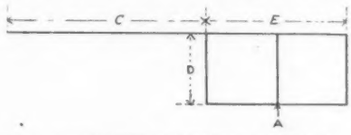


FIG. 2.—CONDUIT BENDING DIAGRAM.

about four inches towards him. The hickey is then moved ½ inch away from the workman and the handle again pulled toward him until it has traveled four inches toward him. This operation is repeated about four times or until the workman can, by looking directly downward from over the elbow, see the 55-inch mark on a line with the outside of the elbow. This will form an elbow with a radius of about 6 inches. Were the workman to move the tee one inch instead of ½ an inch, a much larger radius would be given the elbow. By moving the tee ½ inch and pulling the handle of the hickey 6 inches in place of four inches a much smaller radius would result.

A very small elbow can be made by using a piece of pipe just large enough to slip over the conduit to be bent. In this case the hickey is placed on the conduit so one end of the tee will be two inches away from the mark towards the workman. The "slip" pipe is then placed over the conduit so the end of it will be two inches away from the hickey. The workman pushes the hickey away from him, at the same time pulls the end of the slip pipe toward him. The hickey and slip pipe should be moved away from the workman and the operation repeated several times. This will result in an elbow with a small radius, as the hickey and slip pipe will confine the bending of the conduit to that part of the conduit between the slip pipe and the hickey.

When bending an offset the handle of the hickey is placed downward. The conduit is slipped into the tee and pressed downward. The conduit by this motion is bent through an arc of 45 degrees. The conduit is moved through the tee away

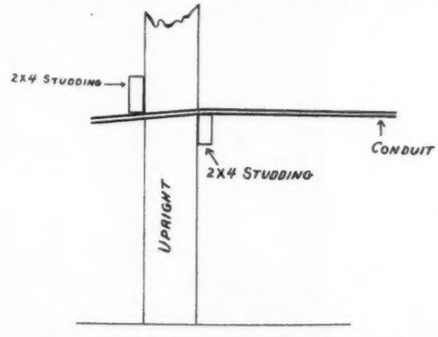


FIG. 3.—METHOD OF BENDING CONDUIT.

from the workman, turned until the end of the bend made points upward, and is then pressed downward again. To bend an offset to agree with a certain measurement, the following procedure obtains: From the conduit already in place to the point where the offset commences, a measurement is taken. From the point where the offset commences to the point where it ends, another measurement is taken. The depth or width of the part which the bend is to offset is also measured. With the last two measurements an oblong is made upon the floor, and from one end of the oblong lay off the length of the first measurement. This forms a good working diagram from which to obtain a fairly accurate bend. Fig. 2 shows the diagram. *C* represents the first measurement, *E* the second and *D* the third. One end of the conduit is placed at the end of *C* and the conduit is marked where *C* and *E* join. The conduit is

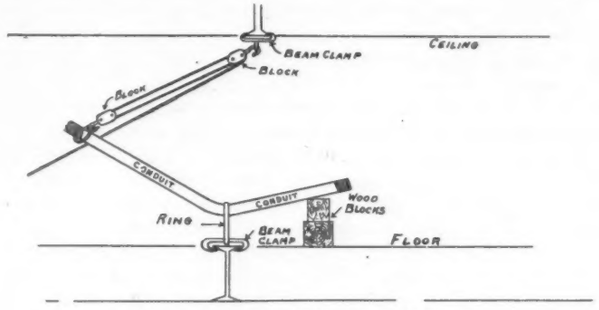


FIG. 4.—BENDING LARGE SIZED CONDUIT.

then placed in the hickey so the mark will be about two inches away from the tee and towards the workman, the end *C* pointing away from him. The conduit is then bent so as to cross the oblong at *A*, which is about midway of the long side of the oblong. The remaining bend can be started about the middle of the oblong. This will bring the bends of the offset within the oblong.

Another way to bend conduit without a hickey, is to fasten two pieces of two by four inch studding to an upright as shown

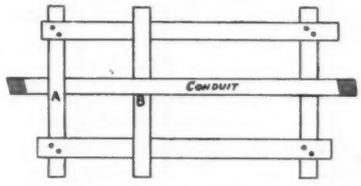


FIG. 5.—PLAN VIEW OF BENDING ARRANGEMENT.

in Fig. 3. It is difficult to bend according to measurement with this plan. The same scheme can be used with offsets, but a piece of slip pipe should be used. To make an elbow one must use the slip pipe. In bending the larger sizes of conduit various plans can be used. One is to fasten a ring made of ½ in. by 2 in. band iron to a solid anchor, such as an iron beam to which it can be clamped or a wooden beam around which a band of iron or chain can be placed. The conduit can be slipped into the ring and blocking used as a fulcrum is placed where the bend is to be made. If the bend is to be as short as possible, the blocks should be close to the ring. If a long bend is to be made the blocks should be placed further away from the ring. The conduit should be pressed downward, and if the conduit from the bend is too short to allow much leverage a piece of slip pipe should be pushed over it. As the

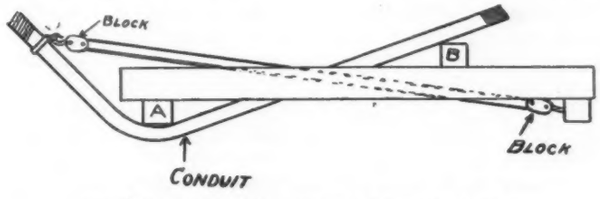


FIG. 6.—BENDING CONDUIT BY MEANS OF TACKLE.

bend increases more blocking should be used, and if it is impossible to bend the conduit sufficiently this way, the conduit can be pushed into the ring until the center of the bend is even with the ring. The conduit can be turned over and an upward pressure exerted. In this case the block should be placed at the end of the conduit on the side of the ring away from the user. A small block should be placed between the ring and the conduit. The wooden block will shape itself as the pressure increases. Were the conduit pressed strongly against the iron band, the conduit, being weaker, would flatten where it came in contact with the edge of the ring.

Should the workman be unable to reach high enough to exert sufficient force to bend the conduit, a tackle can be attached to an anchorage as shown in Fig. 4 and the bend completed by manipulating the tackle.

In places where a ring cannot be used a frame work as shown in Fig. 5 can be constructed of four-inch studding. *B* in the engraving represents a loose block which can be moved as required. The end of the conduit is placed under *A* and the block *B* moved to the point where the conduit is to bend, and a downward pressure exerted. Should it be desired to bend an elbow, the conduit should be bent as much as possible by exerting a downward pressure. (The block *B* can be augmented by more blocking if necessary.) When this is done the conduit should be taken out and placed as shown in Fig. 6. Then a tackle should be attached to the end of the conduit and to the end of the frame work. The tackle should be so arranged that the end of the rope will pull downward. The workman can thus stand on the frame work and his weight will aid in keeping it steady.

When bending conduit it should be watched to see that it does not flatten. When it commences to flatten a strong pull will kink it in such a manner as to render it useless. Unless an elbow of large radius is desired it is always best to use a "factory made" elbow in all sizes over one inch, as it is a difficult matter to bend elbow of comparatively small radius in sizes of conduit over one inch.

The Regulation of Boiler Feeders—IV.

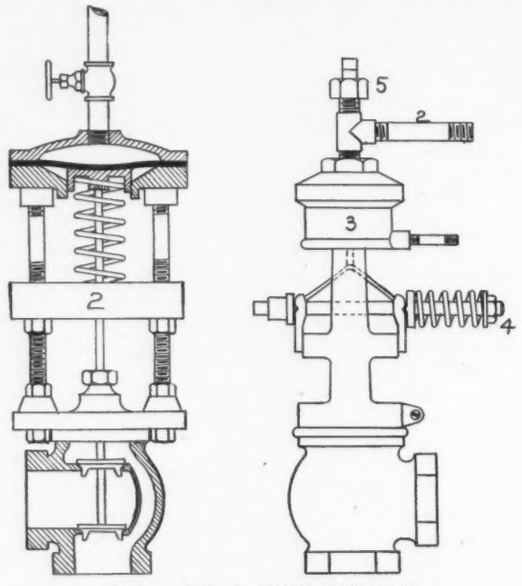
By Charles S. Towne.

In previous issues a number of boiler feed-water regulators and pump governors were described in detail. The present article continues with further descriptions of pump governors and their applications. The three following illustrations show pump governors that possess interesting features, worthy of attention. In Fig. 1 the inlet is at the side and outlet at the bottom according to common practice, but the valve works easily, as it is balanced. It requires but little force to lift it from its seat when tightly closed, for while pressure is acting downward on the lower disk, it tends to force the upper disk in the opposite direction, hence the difference is small. The valve stem is not large and it must only be packed to carry the reduced pressure, hence friction is not excessive. Tension of the spring is changed by raising and lowering the bar, 2.

Fig. 3 is another form of governor in which the pressure from the pump discharge is admitted to the top to close the valve against tension of a spring. The diaphragm in this case is strongly reinforced by a piston and a circle of flexible steel plates. As the rubber is covered by cool water at all times it is very durable. A lip on the under side of the upper piston prevents the disk from rising higher than its present position. The valve is balanced, but in a peculiar way, as the stem where steam acts on it is as large as the steam outlet, hence pressure must be equalized, causing the valve to work easily at all times.

Fig. 2 is of the usual angle valve style with side inlet and bottom outlet. When the discharge pressure is admitted through the pipe, 2, to the cylinder, 3, it acts on a piston the rod of which extends down to the toggle joint, as indicated by the dotted lines. This downward movement spreads the base of the toggles against the tension of the helical (sometimes called spiral) spring which is adjusted to any required pressure by the nut, 4. As the toggles approach a horizontal position, they require less power exerted by the piston to move them a stated distance, but at this time the spring has been compressed until it requires more force than formerly to move it a given distance, hence while one decreases the other increases, making the effect practically constant, or the same as if a dead weight was used for the purpose. The nut, 5, is provided for making adjustments to prevent excessive movement of the piston under rapid changes in pressure.

There is another important feature of this interesting subject that deserves careful attention. When the speed of a direct-acting steam pump that is used to feed a battery of boilers, is regulated by hand, the throttle valve is opened enough to secure the necessary speed. If boiler feed regulators are in use the throttle valve must be opened enough to give full



FIGS. 1 AND 2.—PUMP GOVERNORS.

capacity of the steam pipe in order to meet emergencies. Under such conditions failure of one or more parts to perform the part they were intended to, may cause the pump to run at a high speed, thus doing further damage and perhaps temporarily disabling the plant. To prevent such accidents speed governors are provided which control the pump even if a feed pipe should burst and relieve the discharge pressure instantly, or if the supply of water should be suddenly cut off, no serious results could follow from high speed.

One of these devices applied to a pump is shown in Fig.

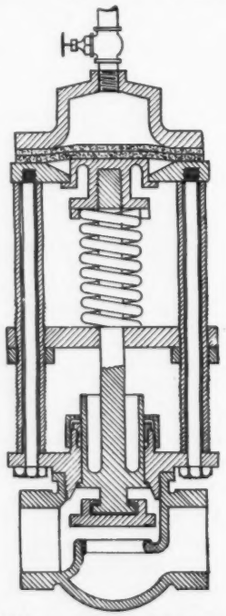


FIG. 3.—PUMP GOVERNOR.

4. The main part consists of an oil pump fastened to the steam chest cover and driven by direct connection to a vibrating arm fastened to a rocker. This oil pump operates a balanced valve above it that allows enough steam to pass to maintain full speed, but no more. The action of this device will be bet-

ter understood by study of Fig. 5, which is a side sectional view of it, also Fig. 6, which is an end view of the same.

Fig. 7 is a sectional view of the balanced valve which controls the supply of steam to the pump cylinder, and of the diaphragm which operates it. The whole apparatus is filled with

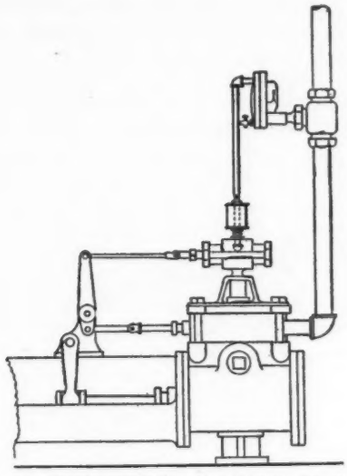


FIG. 4.—SPEED GOVERNOR ATTACHED TO PUMP.

a good quality of light mineral oil, except the oil cup, 2, which should be about three-quarters full. The motion of the main

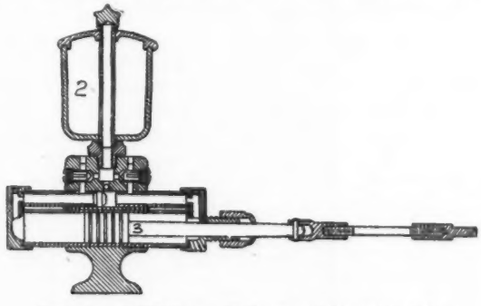


FIG. 5.—SECTIONAL VIEW OF SPEED GOVERNOR.

pump drives the piston, 3, back and forth in the cylinder, forcing the oil out through 4 into the diaphragm chamber, 5. If this was a positive action without relief, the valve would be forced toward the right hand, and quickly closed, but it is not, as there is a needle valve at 6 which is always partly open, thus forming a by-pass around the oil cylinder. Suppose that this governor is set for 60 strokes per minute. So long as the

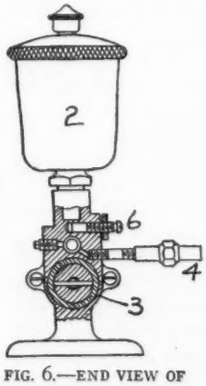


FIG. 6.—END VIEW OF SPEED GOVERNOR.

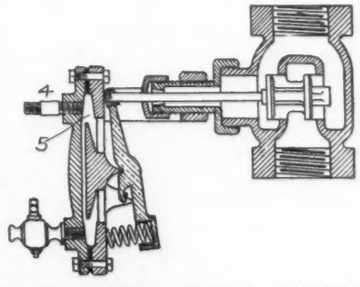


FIG. 7.—SECTIONAL VIEW OF BALANCED VALVE.

speed is less than 60 the oil pumped passes the needle valve and circulates through the by-pass, but if an attempt is made to exceed this speed, the by-pass is not sufficient to handle it, consequently some of it is forced into 5, the diaphragm closes, or partly closes, the balanced valve and the supply of steam is thus limited to what is required to maintain a speed of 60 strokes per minute. It will be noted that this governor is very different in principle and action from a reducing valve that maintains a stated pressure in the steam cylinder regardless of the load on the pump.

Fig. 8 illustrates the same pump applied to a reducing valve for the same purpose. A by-pass made of comparatively small pipe is tapped into the high pressure side, also into the

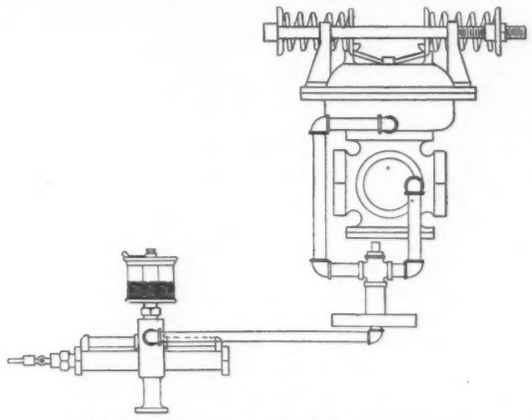


FIG. 8.—GOVERNOR APPLIED TO REDUCING VALVE.

diaphragm chamber. In this by-pass there is a balanced diaphragm valve that is closed under normal conditions. So long as no attempt is made to exceed the speed at which the governor is set, the oil circulates through the by-pass already described, but if the load is suddenly lightened by an accident, thus increasing the speed, the oil pump piston displaces more oil than the by-pass can handle, therefore some of it is forced into the diaphragm chamber of the small valve and it is opened instantly. This admits steam at high pressure to the diaphragm chamber of the large valve, where it overcomes the springs and nearly closes the main valve, thus preventing excessive speed of the pump.

Fig. 9 shows the application of an automatic pump stop that shuts down the pump when for any reason it cannot get more water. It is well known that if drawing from a well or any similar source of supply, and the water level falls below the end of the suction pipe, trouble of some kind due to an uncontrolled pump will follow unless something to prevent it has been adopted. Where this device is in use, a uniform pressure of steam is delivered to the steam cylinder of the pump (as long as the boiler pressure does not fall below what is required), because this pressure acting on a diaphragm tends to close the valve, while the springs act to keep it open as above explained, but an extra attachment appears at the right of this regulator, which is placed in communication with the suction pipe by means of a smaller pipe. This has no effect on the regulator

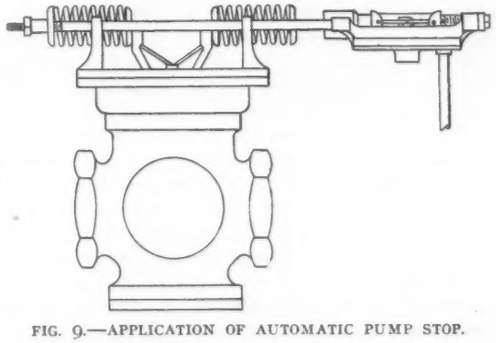


FIG. 9.—APPLICATION OF AUTOMATIC PUMP STOP.

so long as normal conditions prevail, but if the end of this suction pipe is uncovered, the tension of these two coiled springs is at once released, leaving the diaphragm free to close the valve without opposition, and the pump stops until the device is readjusted.

Notes on Roller Bearings.

By Gustave Rennerfelt.

It is a generally well-known fact that roller bearings of the ordinary types, while giving good service when they are newly installed, are apt to break down after continued use for some time. The reason for their breaking down may well be assumed to be the fact that the pressure per unit surface of a roller may for some reason or another become so great as to crush the material in some spot on the surface of the roller. Such excessive pressure may arise from several causes, as actual overload, faulty construction, etc., but the most frequent reason is probably the presence in the bearing of some foreign matter such as a particle of grit or dust.

It is a matter of considerable difficulty to prevent dust from entering a roller bearing, and the dust when entered, will settle on the track in the casing of the bearing, so that the rollers have to pass over it. Since the clearance in a roller bearing is extremely small the roller cannot pass over the grit without undergoing some amount of compression, and since the roller is usually solid, and of fairly small diameter, the compression is apt to be so great that the elastic limit is exceeded. The result is that a small chip will soon break loose from the surface of the roller, the chip remaining in the bearing and causing harm by impeding the motion of the rollers, and by further destroying their surface. Upon examination of a roller bearing which has been in service for some time, but not long enough to cause its complete break-down, it may frequently be observed that the rollers have lost their original high polish, and present a dull gray surface along their whole length or along a part of their length. This change in appearance is due to a partial disintegration of the original bright and hard surface; occasionally actual depressions may be noticed in spots where larger chips have broken off.

When dust or grit has a chance to enter a roller bearing and cause a pressure great enough to destroy the surface of the roller it is evident that nothing will be gained by increasing the number of the rollers in an attempt to distribute the pressure on many rollers. Where grit can locate in a roller bearing having any number of solid rollers the whole pressure from the shaft—and even more—will be momentarily applied to each

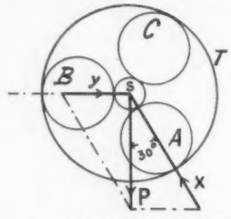


FIG. 1.—THREE-ROLLER BEARING.

one of the rollers irrespective of their number. For the sake of simplicity, if for no other reason, it would therefore seem preferable to limit the rollers to such a number that each would have to sustain the whole load from the shaft—with the supposition that the bearing would be free from dust and that each roller be proportioned so as to be able to withstand the load. This number is four, but no great excess in pressure would result if the number were reduced to three, located 120° apart.

The facts stated above will be made clear by a reference to the diagram of Fig. 1, in which S indicates the shaft; A, B, C, the three rollers; T, the track on which they move; P, the direction and magnitude of the force from the shaft; X and Y, the pressures on the two rollers which support the shaft. During the continued rotation of the shaft the pressure P will be sustained sometimes by two rollers and sometimes by only one roller, and each one of the rollers will be subjected to a pressure varying from a maximum to nil. The maximum pressure on any roller will occur, not at the moment when one roller alone sustains all the pressure, but at a time when the pressure is distributed on two rollers, and when the rollers occupy the position relatively to the direction of P which is shown in Fig. 1. In this position the direction of X forms an angle of 30° with that of P, and the value of X at this moment is

$$X = P \div \cos 30° = P \div .866 = 1.155\,P$$

When the angle is smaller or greater than 30° the value of X becomes smaller. In a roller bearing with three rollers the maximum pressure on a roller will, therefore, normally, not be more than 15.5 per cent greater than the journal pressure proper.

In a roller bearing with five rollers, spaced 72° apart, the pressure from the shaft is carried either on two or on three rollers, and in a well-made and dust-proof bearing of this kind the maximum pressure on any roller should at any moment be smaller than the journal pressure. Some defect in the

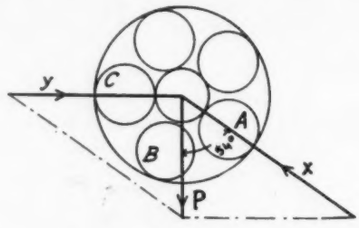


FIG. 2.—FIVE-ROLLER BEARING.

bearing would, however, alter this condition. A reference to Fig. 2 will show that if one of the rollers, B, is a trifle smaller than the other solid rollers it will receive no pressure, and the force, P, will be balanced by the radially directed pressures on the two rollers, A and C. The pressure on roller A is

$$X = P \div \cos 54° = P \div .588 = 1.70\,P$$

This value is a maximum, and becomes smaller for any other position of the rollers relatively to the direction of P. In a commercial bearing of this type an appreciable difference in the size of the rollers may well exist and escape detection, and as a result some of the rollers may be subjected to momentary pressures, frequently repeated, which exceed the journal pressure by 70 per cent. A five-roller bearing is therefore in this respect not at all superior to a three-roller bearing, in which the excess pressure is limited to 15.5 per cent, or to a four-roller bearing, in which the maximum pressure on a roller does not exceed the value of the journal pressure, even in case there should be a slight difference in the diameters of the rollers.

If dust or grit is present on the track the pressure on a roller may evidently reach any value—depending on the elasticity of the roller, and on the size and nature of the grit—but such abnormal pressure will be independent of the number of the rollers. An advantage in using a small number of rollers, such as three or four, lies in the fact that they can be made of large diameter so as to resemble wheels, thus enabling them to roll easier, and they can withstand without damage a greater compression than would a roller of small diameter, resembling a pin. Another advantage is the fact that such a roller of large diameter can for sustaining the same pressure be made of very much shorter length than the roller of smaller diameter. This is important, not only for the purpose of saving space, but for the reason that it will decrease the liability of interference from dust, which liability is somewhat proportional to the length of the roller. Besides causing excessive pressure per unit surface of a roller the dust will also, especially in the case of a long and slender roller, act so as to disturb the alignment of the roller with the shaft. Defective alignment will increase the resistance of the bearing, and it will sometimes cause the breaking of the cage usually relied on for preserving the alignment. Still another advantage of rollers having large diameter is the facility whereby they may be formed hollow and of suitable thickness, so as to offer in any particular case a proper degree of elasticity, enabling them to ride over some slight obstruction without causing enormous pressure.

The above remarks will also apply to a roller having a curved face, so as to constitute the equatorial section of a sphere, which type of roller is in some cases preferable.

LETTERS ON PRACTICAL SUBJECTS.

THE TOOL CHEST AND THE MECHANIC.

The policy of first trying a mechanic with a view of discovering his worth, as one would try an article of manufacture, is an expensive process and not at all practicable, since his wages and the material upon which his trial is conducted are usually a total waste. Therefore, there should be found some tangible points by which the mechanic may be judged from the mere "man with the tools" with probably some knowledge of their use, but with little or no training for their application. Who in practical life has not met such mechanics and paid for work done by them? Who, then, would not hail with delight some method by which they may be told from the genuine article —the real mechanic? Can they not, in fact, be as readily discovered by their "chest of tools" as by the material upon which they have worked and spoiled? As I reflect for inspiration upon this thought I cannot recall an instance of an unskilled mechanic, following the trade, who did not possess more tools than he knew the proper use of. Doubtless, there are two traits in human nature accountable for this. First, the desire to back up lack of experience with a favorable impression. Second, inability to substitute one tool for another, as is the case with an experienced mechanic. With the inexperienced, should the tool not fit the problem at issue, he's stuck, therefore the necessity for many tools. Any able mechanic will, of course, have the fundamental tools required in the proper execution of his work with full reliance upon his ability and experience, while the bad workman, lacking in ability and experience, must balance up in tools.

While I am aware that an instance does not prove a theory, I recall to mind a mechanic who with a bracket saw and pocket knife made me a finished violin from a square of rosewood. When asked why he was not better equipped with tools, he replied that what his work required most was ability, not tools. Again I recall a mechanical draftsman engaged to make a drawing for the Patent Office. His tools were many in number, and of the finest, but his work was so poor that a substitute drawing had to be furnished before the case could be passed to issue. I recall further the case of an electrician who reported for work upon a special job, with a fine leather tool case well equipped with tools. It took him three days to complete a job for which his disgusted employer hadn't the nerve to charge what it had cost him in wages. Therefore I say beware of the mechanic with the "elaborate tool chest."

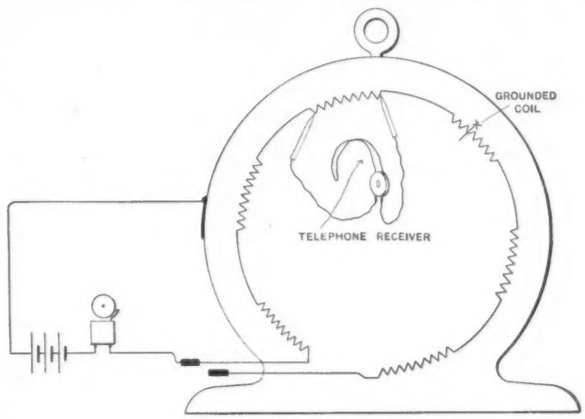
CHICAGO, ILL. CHARLES L. RAFFERTY.

LOCATING GROUNDS IN ALTERNATING-CURRENT MOTORS.

It happens sometimes that the stator coils in alternating-current motors will become grounded, often without giving, even after careful examination, the slightest clue as to the location of the troublesome coil. As it is always desirable to restore a defective motor to service with the least delay possible, any means that will contribute to that end the writer feels will be appreciated by all concerned.

It is no difficult task to disconnect a few damaged coils, close the circuit around them, and start the motor, leaving the replacing of the coils until a more convenient time. The point is to locate the seat of the trouble quickly and without removing the rotor or otherwise taking apart the machine, and assuming that such a case is to be dealt with, the following method may be used:

A small "watch case" telephone-receiver is required, with 3 or 4 ft. of conductor attached, and connected to two sharp pointed terminals; a couple of old rat-tail files ground on the ends to a sharp point will do. Next the motor leads are disconnected and one wire of a loop from a circuit of a couple of lighted incandescent lamps is connected to the terminal of the grounded phase, the other wire to the motor frame, so that there will be an ampere or two of current flowing from one terminal of the grounded phase through its pole windings to the grounded coil or coils and out through the frame of the motor. It will not, of course, flow beyond the grounded coil. This current will produce a slight difference of potential between the beginning and the end of each pole-winding it flows through on its way to the ground, and this the receiver will be able to detect. Attach the head-receiver and with a point in either hand select one of the poles of the grounded phase near its connected terminal. Force one point through the insulation into contact with the beginning of the pole winding and the other



LOCATING GROUNDED STATOR COIL.

one likewise at the end of the same. If now, on breaking the receiver circuit, which can best be done by a push button in the hand, a "click" is heard, it is evidence that the connection is between the terminal and the grounded coil. As the direction of the latter is now known the operation may be repeated at each successive pole of the phase in question until no current is detected, at which point the grounded pole will have been passed. The individual coils of the latter may now be tested in the same way and the exact coil or coils located. If electric light current be unavailable a couple of dry cells with an electric bell in circuit to avoid short-circuiting the batteries will answer the purpose.

This method will be found easy, rapid and effective.

TOLEDO, OHIO. LEONARD WORK.

CURRENT REQUIRED BY DIRECT AND ALTERNATING-CURRENT MOTORS.

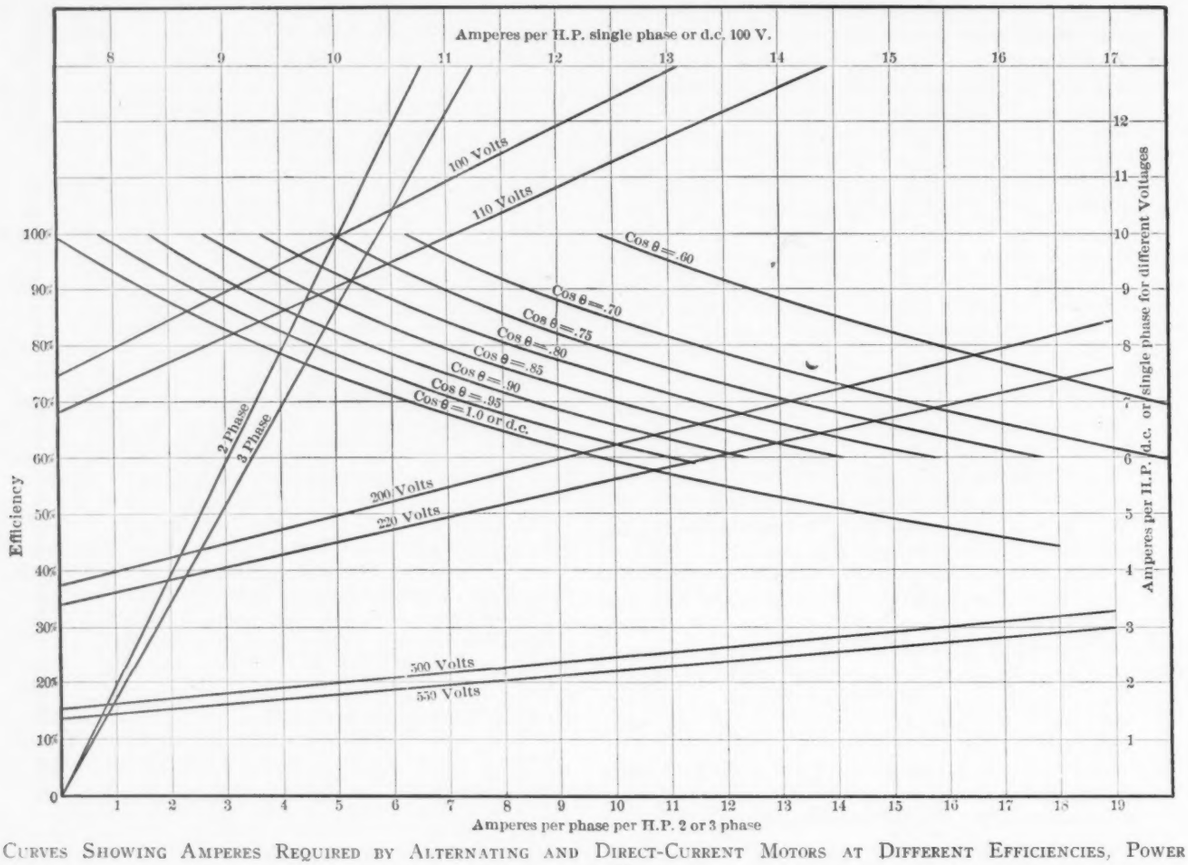
Curves of the character similar to the one published in this article are more useful for arriving at results without extensive calculations than tables, in which it would be impracticable to give all the different values for all the factors any possible case may contain. In such a table, for example, values of the current taken by motors at 80 per cent and 90 per cent efficiency may be given, and to find the current at 85 per cent efficiency the current required can be approximated by taking a value between these two values. The error being smaller the closer together the two values given in such a table are on the curve, and depending upon how near this part of the curve between these two points approximates to a straight line.

Another advantage, for example, is that the curves may have been plotted for some particular voltage, for instance, 220 volts, and if the current at 200 or any other voltage is desired, all that is necessary is to draw another line over the curves, as was done in the accompanying curves for 100, 110, 200, 220, 500 and 550 volts.

The efficiency of a motor depends upon the size, type and load conditions under which it is operating. Now, suppose, it is desired to know the current required per horse-power by a 100-volt direct-current motor at 74.6 per cent efficiency. By following the line from this efficiency over to the right until it intersects the curve for unity power factor or direct current and then up to the top of the chart, 10 amperes will be found

as the answer. A 200-volt motor at the same efficiency will take 5 amperes per horse-power, which is found by following down from the intersection of the efficiency with the direct-current curve or unity power factor to the 200-volt line, and then over to the right of the chart.

In a similar manner, the current required by the alternating-current motor is found by tracing the efficiency over to the right to the point of intersection with the required power-factor, and then to the top of the chart for 100 volt, single-phase motor; and to the different voltage lines and then to right for


Amperes per H.P. single phase or d.c. 100 V.
100 Volts
110 Volts
Cos θ = .60
Cos θ = .70
Cos θ = .75
Cos θ = .80
Cos θ = .85
Cos θ = .90
Cos θ = .95
Cos θ = 1.0 or d.c.
2 Phase
3 Phase
200 Volts
220 Volts
500 Volts
550 Volts
Efficiency
Amperes per H.P. d.c. or single phase for different Voltages
Amperes per phase per H.P. 2 or 3 phase

Curves Showing Amperes Required by Alternating and Direct-Current Motors at Different Efficiencies, Power Factors and Voltages.

the other voltages, or from the last point on the voltage line to the two or three-phase line horizontally, and then down to the bottom of chart for two or three-phase motors. Examples: A single-phase motor at 74.6 per cent efficiency, 80 per cent power factor at 100 volts, required 12½ amperes per horse-power. A three-phase, 200-volt motor will be found to require 2.81 amperes at 85 per cent efficiency and 90 per cent power factor.

These curves were plotted by assuming different values for the efficiency to find the points on the various power-factor curves at 100 volts and the voltage lines were drawn by proportion.

It would be impossible to include in these curves the efficiency of the various types and sizes of motors on the market. The average reader has fairly well in mind the results that can be obtained from any given class of machines and exact guarantees can be obtained from the manufacturers. The average full load efficiency of 220-volt, direct-current motors between 1 and 15 horse-power ranges from 65 to 85 per cent respectively, and from 15 to 150 horse-power, 85 to 92 per cent.

The full load efficiency of alternating-current motors is a few per cent less than direct current and is dependent upon the frequency, design and type. The power-factor varies between 80 and 90 per cent for 1 to 10 horse-power motors and from 90 per cent to 93 per cent for 15 to 150-hp motors.

San Francisco, Cal. Otto F. Falch, Jr.

NOTES ON LIGHTNING PROTECTION.

This subject is perhaps one of the most unsatisfactory subjects with which the electrical engineer has to deal. The design of a proper lightning arrester cannot be accomplished by resorting to careful calculations. Experimental data are by far the most reliable, and this combined with a due regard for the known general laws is practically all the means that the designer has at his command.

A good lightning arrester should accomplish three things. First, it should establish a path of preference for a high potential discharge of whatever nature it may be. Second, it should successfully interrupt and extinguish the following dynamic arc, if there be one. And lastly, it should restore itself to its former condition ready to receive and transmit another abnormal surge of pressure.

The lightning arrester may be regarded as a sort of safety valve and it is more truly the analogue of the steam safety valve than is the electric fuse. It is a weak point in the insulation of the line which bursts when a safe pressure is exceeded and relieves the pressure, thereby saving the expensive insulation.

The most common form of high pressure presence in an electric line is that due to natural causes, more briefly lightning. Lightning discharges are almost invariably the result of a condenser action between a charged cloud and the earth, and hence are oscillatory in their nature and present the enormous frequency of the so-called Tesla currents. Mr. Tesla by his brilliant experiments on this subject has done much to make us familiar with these laws and has shown us that the impedances presented to such currents as these are enormously different from the impedances presented to commercial currents. Hence we have experimental confirmation of the well-known forms of spark gap arrester which conclusively show that a straight path to earth intercepted by a small spark gap, even in spite of the enormous ohmic resistance of this gap, presents to an oscillatory

discharge a much less impedance than a metallic circuit intricate in its form, and often coiled around iron, which is always the form of the commercial circuit that we desire to protect.

As far as taking care of the first discharge is concerned, it would seem that an adequate spark gap of sufficient length so as not to be in danger of being bridged by the line potential but sufficiently short so that a pressure likely to break down the insulation would easily bridge the gap, would be sufficient. This is correct theoretically, but practically it has been found necessary to divide up this gap into a series of gaps, a principal reason for this being the necessity of dividing up the calorific among different localities and thereby rendering the extinction of the following arc more likely.

In the use of the spark-gap arrester a formidable difficulty presents itself in endeavoring to protect low voltage lines. Taking, for instance, the common pressure of 110 volts, where it is not desirable to have a pressure of over 1000 volts on the line, it will appear at once from consulting the spark-gap tables, that a spark gap of .03 millimeters is all that can be used, if it is to break down at 1000 volts. Such microscopic gaps as this are out of the question in commercial practice, for they can easily be bridged by particles of dust, are difficult to construct mechanically, and a resulting arc is absolutely certain to maintain across them.

It is therefore a fact that in all forms of lightning arresters having stationary parts that the gross sum of the spark gap resistances is enormously greater than it is desirable to have it from a theoretical standpoint. Nevertheless, these commercial arresters have been installed on local systems and have undoubtedly afforded protection under critical circumstances as test papers have shown, and should be installed together with kicking coils and a liberal trust in Providence. In other words, they are better than none at all.

The subject of a short spark gap for a static or high potential surge and a long spark gap for the following dynamic arc, has been much studied and many devices have been evolved to permit of the minimizing of the one and the enlargement of the other or its equivalent. Many of these are mechanical devices which act as soon as the discharge has passed, opening up the gap, but of these many are open to the objection that damage is being done at a very rapid rate and the mechanical action of the devices is too slow. A very large class of arresters utilizes the principle that the vapor of zinc does not tend to promote an arc and consequently make their spark gap termini of metals, the essential principle of which is zinc. Pure zinc at present will not answer, because being so readily fused it is likely to splash across and bridge the gap. Hence have sprung into prominence numerous non-arcing metals which appear and oftentimes assay suspiciously like brass but which to a certain extent, more or less, have value.

The use of high resistance carbon in series with an arrester is quite extensive and is a feature of undoubted value. Its resistance contributes little to the impedance of the arrester when traversed by an oscillatory discharge, and if the rod, ring or disc, whatever it may be, survives the oscillatory discharge, its ohmic resistance reducing the following arc to proportions which can often be dealt with. The shunting of a portion of the air gaps by resistance rods has a beneficial effect, for it seems that an arc is very much less likely to maintain across gaps so shunted.

A feature of value in the construction of air gaps for lightning arresters is the provision of a surface of solid insulation over which the static discharge can creep. It is a fact, which is not perhaps generally well known, that a static discharge capable of jumping an air gap of say, one-eighth of an inch, will easily span a considerably greater distance if the points be placed touching a surface of glass, mica, or equivalent insulation. The conducting powers of an insulating surface seem to be greater than those of an air gap pure and simple. Certain classes of arresters utilize this principle by compelling the discharge to traverse the surface of mica disks. The dynamic discharge does not seem to follow the mica disks but arches around them, and such an arrester constructed of high resistance carbon rings seems to be very efficient.

The use of iron cases or enclosures for lightning arresters in the writer's estimation should not be recommended. The opinion is based, first, upon practical experience in which it has been found that more often the lightning discharge has preferred to break down the insulation between the wire and the case at the entering and leaving ends, and not to traverse the arrester, and upon the theoretical consideration that an iron enclosure about a conductor presents a needless contributing inductance to the joint impedance of the whole circuit.

It is safe to say that while many arresters efficiently satisfy the condition of providing a path of relatively low inpedance to the earth, that all of them to a greater or less extent fail to satisfy the second condition, that of extinguishing the following calorific arc. They should therefore be regarded, to a certain extent at least, more as a fuse is regarded. Let the arrester be destroyed by the lightning stroke; pay the bill, and be thankful that the $10,000 dynamo has escaped.

Owing to the fact that the average practical user of electrical apparatus is apt to estimate the value of a piece of apparatus by the trouble that he has with it, too many such are apt to condemn the arrester which blows to pieces and to prefer the one which is never heard from. It would seem to the writer that the user of arresters should congratulate himself when upon such an accident, which has found an undoubted primary cause in lightning, the arrester has fulfilled the first condition. Damage has been averted and he is much better off than the man whose lightning arresters are all intact, and therefore in his estimation good pieces of apparatus, and who consoles himself with the fact that the breakdown in his machine was due to the peculiar way in which the lightning struck the line, and that such accidents are inevitable to a certain extent any way. It does not follow that the fuse is a good fuse because it never blows.

The electric safety valve idea of a lightning arrester combined with the idea that such a piece of apparatus is a weak spot in the insulation of the line, certain to break down under stress, and easily repaired, in other words, self healing, suggests the use of the best self-healing medium that we know, namely, oil. The oil gap has much to recommend it. In the first place it is independent of weather conditions. It has as nearly a constant breakdown voltage as a dielectric can possibly have. Second, it is self-healing as soon as the disturbance has ceased, provided that the dynamic arc is not sufficient to maintain within the oil. Lately some important strides have been made in oil arresters which promise a high degree of success.

An oil gap one of the terminals of which is in continuously rapid motion and abruptly enlarges the gap eight to ten times the normal distance will carry the following arc with it in spite of the fact that the original gap is restored by a following conductor, such as the second spoke of a wheel of which the active gap is the first spoke. Such an arrester requires power and is only suitable for central station work. But as the oil break switch seems to be the only means by which we can successfully open heavy high voltage circuits, it would seem that the devices recently patented should develop important features of success in high potential protection.

The second cause of disturbances in a line are those due to surges, which are for the most part caused by sudden breaking of circuits or by short circuits. These surges are often quite as destructive in their effect as lightning discharges, and with them the air gap arrester of any type is practically unable to cope. The periodic frequency of these surges is very low, comparable indeed with the natural frequency of the line, and the laws which make the air gap arrester effective do not hold, or better said, they do hold in such a way that the impedance of the air gap arrester is much higher than that of a path surrounded by expensive insulation and construction.

In this field the oil break arrester will undoubtedly have great value, for its gap can be set without fear of trouble, very much closer to the normal insulation of the line, or even weaker than the normal insulation of the line, in which case it will prove an abundant protection. It remains for the various patentees of the different forms of oil gap arresters to so perfect their principles that the following arcs can be dealt with, and the

oil switch seems to show us that this can be done. That a perfected arrester of this type will be a welcome advent to those who have to deal with our modern high voltage transmission systems can scarcely be doubted.

New York City. J. H. Kohler.

A LEAKY BLOW-OFF VALVE AND ITS COST.

"I am burning a ton of coal a day more than I did a year ago, and not doing a bit more work with the engine," was the remark recently made to the writer by a factory owner who not only manufactured lumber in the day time, but generated electricity at night and sold it to the neighbors for lighting purposes.

Upon looking over his steam plant, everything was found in what seemed to be fairly good shape. The boiler seemed clean

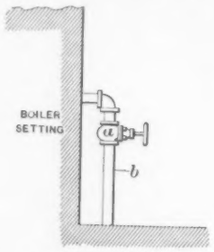


FIG. 1.—BAD BLOW-OFF CONNECTION.

and the feed water-heater was working properly. Still, as near as could be ascertained, without making a regular evaporation test, the boiler was burning four tons of coal where it formerly burned three. Making a rough calculation of the amount of water actually evaporated each hour, by noting the time and approximate quantity of coal required to lower the water level 2 ins. in the boiler, the writer quickly became satisfied that the boiler was surely evaporating water at the rate of nearly 9 lbs. of water to the pound of coal.

This being the case, it was in order to search for leaks and suspicion fell upon the blow-off pipe at once, and upon looking up this pipe, it was found to be buried in the ground and to discharge into a sewer in such a manner that no man could tell whether the valve was leaking or whether it was tight. Taking a chance, but a pretty sure one, the blow-off was cut off with a pipe cutter at *b* Fig. 1, just below the bolted-bonnet, asbestos-packed, blow-off valve *a*. As soon as the pipe cutter went through the metal, water followed the cut, and, after the pipe was severed, and the upper end twisted to one side, a nice little stream of smoking hot water was found making its way to the sewer. A bucket was placed under the pipe and filled with water and the time was carefully noted while the

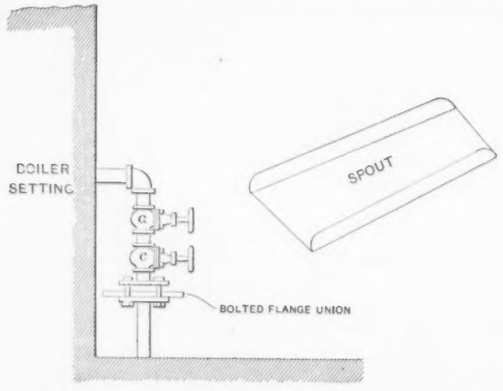


FIG. 2.—METHOD OF IMPROVING BLOW-OFF CONNECTION.

water was being caught in the pail. The pail and its contents were then carefully weighed, the water thrown out, the pail weighed again, and the net weight of the water found, which, together with the time in which the water was caught, was laid aside for calculation later.

Next, a piece was cut out of the sewer-connection pipe which was arranged so that it had 4 or 5 ins. vertical movement. The sewer end of the pipe was loosened so that the pipe could be moved readily up and down the distance noted. Next, another valve was put on, as shown at *c*, Fig. 2, then a bolted flange union was adjusted with long bolts which had their threads cut on a distance sufficient to allow of the union flanges being drawn together.

During normal running conditions, the pipe and its fittings should remain as shown by the engraving, the flanges of the union being separated enough to allow the zinc spout to be introduced between the flanges. This spout, as shown in detail, is a simple sheet of zinc bent up so as to just pass between two opposite bolts of the flange union. Only two bolts are necessary, that number being sufficient to hold the pipe against the comparatively slight pressure of blowing off. The nuts may be tightened up with the fingers sufficiently and after blowing down the required amount, it is only the work of a single minute to slacken the nuts again and replace the zinc spout. Then it is impossible for the valve to leak without the attendant being aware of the fact, for instead of the leakage going unseen into the sewer, it now falls upon the boiler room floor, verifying the old adage that "seeing is believing."

It will be noticed that in the new blow-off arrangement two valves are used. This matter has been the subject of a great deal of discussion on the part of engineers, some claiming that two valves are no better than one valve, while other engineers claim that with two valves they will both remain tight while with one valve it is leaking all the time.

The writer believes in having two valves on the blow-off of a boiler in all cases. He knows that if one or both the valves leak, he can close the valve next to the boiler and that it will be tight enough to enable him to grind tight the outer valve, or to put in a new disk or even a new valve, if necessary. This can be done even with a considerable leakage in the inner valve. With but a single valve it is impossible to grind it or

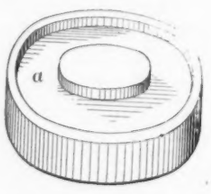


FIG. 3.—WORN DISK OF BLOW-OFF VALVE.

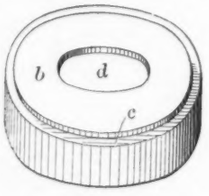


FIG. 4.—METAL DISK RING AFTER RECASTING.

to replace the valve or disk without first completely emptying the boiler. The double blow-off valve arrangement places the valve matter entirely within control of the engineer.

The asbestos packed iron body blow-off valve has proved very serviceable to the writer, and he regards it as a very good blow-off valve for general use. The valve in question is fitted with lead disks, the lead being cast in an annular ring. When the lead becomes so badly cut by dirt or other foreign substances, scale, for instance, that the valve cannot readily be made tight by grinding in the usual way, then the lead disk may be melted out and recast in a very few minutes. Some engineers use babbitt metal for replacing the disk when necessary, while others have had the lead replaced by pure soft copper, which can be done in the nearest brass foundry.

The writer has not found it good practice to regrind this type of valve many times. After two or three grindings it is better to melt out the old disk packing and cast in a new one. The reason for this is illustrated by Fig. 3, in which the soft metal ring, *a*, is shown to be a slight distance below the surface of the disk. With the soft metal in this condition, no matter how well the valve may be reground it will not stay tight, owing to the collection of scale and other foreign matter in the channel above the soft packing ring. With a few pieces of scale caught in the channel, it only needs a screwing down of the valve to fix the soft ring so it will leak badly.

It is better to keep new packing in these valves, and never wear it below the surface of the iron. Fig. 4 shows how one of these disks appears after being recast with the soft metal at *b* a little higher than the iron center and outside *d* and *c*. When the metal gets worn or ground down even, recast it at once.

NEW YORK CITY. JAMES FRANCIS.

TROUBLE WITH A STEAM TRAP.

Some time ago the writer briefly described the trouble met with in operating a kettle trap; and the remedy, by weighting the kettle, was also mentioned. Since then another but much more troublesome case has come to the writer's notice.

The trap in question was an 18-in. trap, tapped for 1½-in. connections, and designed to work under 100 lbs. gauge pressure. The trap was put in service under a pressure of 125 lbs., and frequently it was subjected to 135 and even 140 lbs. to the

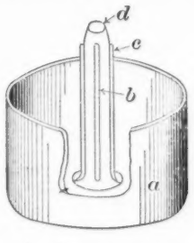


FIG. 1.—TRAP BOWL AND VALVE STEM.

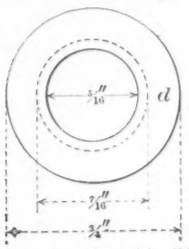


FIG. 3.—END OF VALVE STEM.

square inch. The trap failed to work regularly under the higher pressures. When clean, and after having been overhauled and cleaned, it would work fairly well for a day or two, but it would frequently fail to act and seemed to stick and required the jarring of a piece of scantling upon the cover of the trap to start it working.

The writer being called in to see what was the matter with the trap, determined to instruct the attendant so that he would thoroughly understand what happened in the trap, and be able to act by himself in future cases. The kettle trap, as some know and all should understand, acts through the difference in weight of a cast-iron basin when filled with water and when displacing water to the extent of its volume as a vessel.

By referring to Fig. 1, the action of the kettle trap may perhaps be made more plain. The cast-iron pot or kettle, *a*, is made as thin as convenient to construct from cast-iron. The long valve stem, *b*, is firmly attached to the bottom of the kettle and three or four lugs—the latter number is preferable—extend from top to bottom of the valve stem. These lugs are

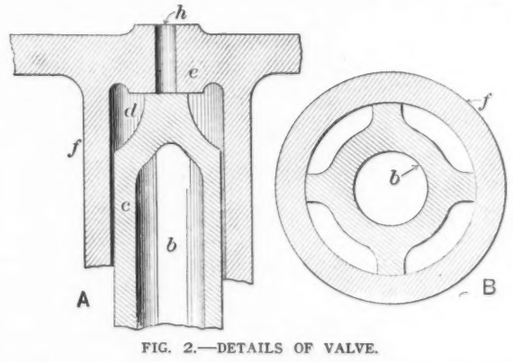


FIG. 2.—DETAILS OF VALVE.

turned in a lathe, the rest of the kettle being left as it comes from the foundry, excepting that it is balanced if necessary, so that when floating freely in water, the valve stem *b*, will stand exactly vertical.

The valve stem *b* has, as stated, the turned lugs *c*, which should be kept clean, free from dirt of all kinds, particularly an accumulation of rust or scale. The valve face, *d*, should be bright, smooth and clean. It should be ground into or against the valve seat with powdered glass, sand or some other abrasive substance in exactly the manner that any valve is ground to its seat. Fig. 2 shows stem *b*, in position inside the sleeve *f*, which extends from the top of the trap nearly to the bottom of the kettle. It is between the valve stem *d*, and the seat *e*, that all the troubles occur. As the engraving shows there seems but very little room for water to flow between *b* and *f*, but by looking at the cross-section it is apparent that there is plenty of room for water in the sleeve *f* beside the stem *b*.

When the trap is put together, it is found to require pressure to push the kettle, *a*, Fig. 1, down into the water, as the displacement of the kettle is quite large. As this pressure comes between *d* and *e* Fig. 2, it is evident that there is plenty of power (in the upward pressure mentioned) to keep the opening *h* fully closed except when the trap is to discharge. The emptying of the trap is brought about by the rising of water outside the kettle, until it finally rises above the top and eventually fills the bowl full of water. It is now evident that the buoyancy due to water displacement has been lost, and that all the upward pressure is removed from the stem, except that due to unbalanced steam pressure against the area of the opening *h*, Fig. 2.

Referring to Fig. 3, the diameter of the discharge opening *d*, is 5/16-in., giving an area of .0766 sq. in. With a pressure of 125 lbs., there is an upward steam pressure of 9.54 lbs. tending to keep the pot afloat when it is full of water and it is necessary that the kettle shall weigh more than the stated amount when submerged in water.

Thus, the kettle which must weigh at least 9.57 lbs. in water in order to balance the steam pressure, must weigh about 11.13 lbs. in air to make up for the loss of weight in water. The kettle surely weighs more than this amount, hence it is necessary to look elsewhere for the cause of the trouble, which is finally located in the diameter of the end of valve-stem *d*, Fig. 2, which is seen to be considerably larger than the diameter of the opening *h*. It is proven very conclusively, to the complete satisfaction of the writer, at least, that the unbalanced steam pressure can and does frequently mount up to a quantity due to the entire outside diameter of the stem *d*, instead of the area of the opening for discharge. The external diameter of stem *d* is ¾ in., equivalent to an area of .441 sq. in. Under 125 lbs. pressure, this surface would carry a weight of 55.12 lbs. This, regarded as water weight, calls for about 64.3 lbs. air weight to drop the kettle after it has filled with water.

Two courses are open to remedy this difficulty, it being found that the opening *h* cannot well be made smaller, owing to the quantity of water to be discharged. It is necessary either to reduce the external diameter of the valve stem *d*, as shown by the dotted circle in Fig. 3, which would reduce the area of the stem to a point which would render it impossible to build up so great an unsupported or unbalanced steam pressure or weight the kettle.

A stem cut down in this manner does not stay tight a great while, the metal being so thin that the least particle of dirt caught between the surfaces is forced into and cuts the valve surfaces so that they are never tight again until regrinding has been done, and then the same thing repeats itself again very quickly.

The trap was weighted and put in commission and was found to work perfectly under all pressures up to 135 pounds. It was feared by the owner that the trap thus weighted would not work when the pressure happened to fall to 100 lbs. or less; but this was not found to be the case. Under a low steam pressure, the trap merely worked a little quicker, but not enough to be noticeable. With the added weight in the kettle and with lower steam pressure, the kettle would sink before it quite filled with water, therefore it worked at more frequent intervals and discharged less water at each time. In fact, weighting the kettle and lowering the steam pressure simply reduces the capacity of the trap to a certain extent. Otherwise there is no harm done by using a loaded trap under lower pressure than it is adjusted for.

WILLOUGHBY, OHIO. JAMES F. HOBART.

QUESTIONS AND ANSWERS.

In several recent designs of induction motors the copper end rings of the squirrel-cage rotors are carried an inch or so beyond the core. As this requires more copper and increases the resistance, what counterbalancing advantages follow from this construction? H. B. B.

This construction is probably due to an attempt to provide improved facilities for cooling the secondary windings and thus obtain increased capacity from a motor of given dimensions.

A large dome was wired for 300 lamps and tested free. After the building was completed and the scaffolding removed the fuses on one pair of feeders blew, due to a ground. The Edison three-wire service is used. Can you suggest a quick way of locating and removing the ground? It would be a very expensive matter to go over all the wiring now. F. L. D.

If the conditions are as stated they may be easily remedied by shifting the position of the feed wires, or in other words by shifting the neutral. If the ground is on the positive side of the system, connect the positive wire to the neutral feeder and the neutral wire to the positive feeder.

What type of condenser is the best to use in a locality where water is scarce and room is of no consideration? G. O.

Evaporative condensers are usually used in such cases. In these, the exhaust steam is led through a large number of pipes cooled externally by trickling streams of water. This water evaporates, thus condensing the exhaust steam in the pipes, which is then pumped back to the boiler or otherwise disposed of. In well designed condensers of this type one pound of water will condense one pound of steam, as against 20 to 30 pounds of water required in jet and surface condensers.

What should be the size of the neutral wire as compared with the outside wires of a three-wire system? The system is to be used for mains and feeders in a large building. R. B. U.

The size of the neutral depends on the nature of the load. If the circuits are well balanced, the neutral wire may be smaller than the wire used in the outers; about one-half the cross-section of the outer wire is common practice under such conditions. Where there is a probability of unbalancing, this must be increased, and if one side of the circuit is apt to be used without the other, the three wires should be of the same size. Where there is a possibility of changing over to a two wire system, it is quite common to install the neutral wire double the size of either of the outer wires.

Could you inform us whether or not it was good engineering practice as late as 1903 not to insulate the frame of a 2400-volt, alternating-current generator from the ground? R. & Z.

The National Board of Fire Underwriters required up to 1906 that all generators be thoroughly insulated from the ground wherever feasible. Where this was impossible permission was given for its omission, in which case the frame had to be permanently and effectively grounded. It was suggested that the generator be surrounded by an insulated platform so arranged that it was necessary for a man to stand on the platform in order to touch any part of the generator. The revised Code calls for the grounding of all generators operating at a potential in excess of 550 volts, the recommendation that an insulated platform surround the high-potential machines still being in force.

Please describe the features of the Ilgner system of drive for mine haulage. H. F.

The Ilgner method of mine haulage consists of supplying direct-current to the winding motor from a generator which is driven by a three-phase induction motor coupled on the same shaft. Between the two machines, a heavy flywheel is mounted. When the load is light, energy is stored in the flywheel and this is given out to the generator on starting up the trucks, etc., thus tending to keep the load on the induction motor constant. The benefit of this system of driving is that full advantage is taken of the elasticity of the direct-current motor, as the speed can be controlled by altering the excitation of the generator, thus raising or lowering the pressure applied to the motor, without inserting resistance in the main circuit. There are also no heavy and sudden fluctations of current drawn from the main supply, due to the use of the heavy flywheel.

In our station we are troubled by air leakage through the brickwork of the boiler settings. Is it possible to remedy this without resetting the brickwork? If so, what precaution should be adopted? R. S.

The trouble is doubtless due to cracks in the walls, or to the walls being built of ordinary brick. It is well known that all heat-dried brick is highly porous and unless specially treated to render it air-proof, a boiler setting built of it is very unsatisfactory. The air suction through the walls of unproofed brick may be demonstrated by means of the flame of a candle or lamp. Although such brick is still used, modern practice requires glazed brick, tile or bindled brick. To counteract the bad effects due to porous brickwork, the commonest practice is to paint the surface with a mixture of tar, or a paint with a varnish body. Faulty setting due to bad workmanship cannot be thus corrected. If cracks are present and are not of such dimensions as to necessitate resetting the brickwork, these should be pointed up. The application of a thin cement by brush has also given good results.

What is best to install in connection with generators running in parallel, single or double pole circuit breakers? What effect would the opening of a single-pole circuit breaker have on generators running in parallel? What difference does it make if in a 110-volt, 100 ampere circuit a 110-ampere, 220-volt fuse is used in place of the 100-ampere, 110-volt fuse? H. E. V.

The use of single or of double-pole circuit breakers depends on the installation. In railway practice, single-pole circuit breakers are used, while for ordinary lighting circuits double-pole circuit-breakers are preferable, since both legs of the circuit are opened. Where two generators fitted with single-pole circuit-breakers are running in parallel and one of the circuit breakers opens, it means that the load would be shifted to the other generator, and if the load was sufficient to overload the latter machine, its circuit breaker, if properly set, would also open. Enclosed fuses for voltages up to 250 are for rated capacity, similar in size and construction. With the 110-volt link fuse, the minimum spacing allowable between terminals of like polarity is ½ in. while the space allowable for a 200-volt link fuse is ¾ in. This is because the power in the latter case is greater than in the former case. For the same reason one would not use the same switch for a 10-ampere, 110-volt circuit, as he would use for a 10-ampere, 11,000-volt circuit, although the current in each case is the same.

What is the best substance to use on commutators of motors that spark badly? We have a number of 220-volt motors in use and have more trouble from sparking than from all other causes combined. A. T. N.

As has been pointed out in this department before, no amount of commutator compound can rectify sparking due to faulty design. With a properly designed machine, if greasy lubricants are used on the commutator, these serve rather to cause sparking than to prevent it, since most of the substance will collect around the foot of the brush, where it quickly accumulates dirt and dust. A commutator and brushes kept clean and in a dry condition attract little dirt and dust. Pitting of segments is very often traced to an immoderate use of commutator compounds. In such cases the mica becomes coated with a tough varnish formed of uncarbonized and carbonized oily particles over which the brushes jump. The principal advantage of commutator compounds is the lessening of noise, which may be anything from a hum to a shriek, by a reduction in the friction. Vaseline in very minute quantities has been found useful for this purpose. Paraffin compounds are also used to some extent and there are a number of good commutator compounds on the market. Where hard carbon brushes are used some lubricant is necessary to subdue the screeching noise. If due regard is given to the care of commutators and brushes, very little lubricating substances will be necessary.

CENTRAL STATION SALE OF CURRENT

Electric Service at the Seashore.

BY CARMELITA BECKWITH.

The Queens Borough Gas & Electric Company at Far Rockaway, Long Island, occupies a peculiar position. It operates in Greater New York, and yet supplies current only to seaside resorts; in fact its plant is at a summer resort and subject to the conditions of such surroundings. The company's mains cover a territory of 18 miles, comprising 15 small towns, Belle

FIG. 1.—MAP OF TERRITORY SERVED BY THE QUEENS BOROUGH GAS & ELECTRIC COMPANY.

Harbor, Rockaway Park, Hollands, Hammels, Arverne, Edgemere, Far Rockaway, Lawrence, Inwood, Cedarhurst, Woodmere, Hewlett, East Rockaway, Lynbrook, Valley Stream and Oceanside as shown by the map, Fig. 1.

It is a problem to set and reset meters for about 3,500 con-

A Great Bargain
WE ARE GOING TO FURNISH OUR CUSTOMERS WITH A BEAUTIFUL ELECTRIC PORTABLE LAMP, COMPLETE FOR $3.75
TAKE A LOOK AT IT, IN OUR OFFICE
See For Yourself
THE "SUNLIGHT" ELECTRIC PORTABLE
Queens Borough Gas & Electric Co.
347 Central Ave., Far Rockaway
'Phone 62 Far Rockaway

FIG. 2.—ELECTRIC PORTABLE LAMP ADVERTISEMENT.

sumers at the rate of 150 to 200 a day. Every spring and fall these Queens Borough meters must be disconnected, read and bills rendered sometimes within one week. The manager of the ordinary plant can grasp the magnitude of a situation of this sort. "This is probably the most expensive plant to operate in New York State," said Mr. Carleton Macy, the president of the company, "because of the peculiar conditions. We supply energy to shore resorts and country districts, all included in New York City—an extremely large population for about two and a half to three months in the summer, and a comparatively small one for the rest of the year."

Mr. Macy believes in advertising, keeping everlastingly before his public the name and ability of his company to supply everybody's needs. "At the present time," he said, " as a result of pushing electric power, the day far exceeds the night load of this company. Our ratio is 1 to 6, which I think is a good showing when it is considered that the regular population of this territory is estimated at 10,000 and the summer colony swells the figures to 70,000."

Large space in every newspaper is used and copy is changed in each issue. Plenty of white space is shown in the advertisements, usually a cut, and a timely one. For instance, about last election-time the ads read: "Democrats and Republicans all rally around the electric heater." (Cut of heater.) "They all vote for it." At Christmas time cuts of all sorts of heating and cooking devices were advertised as acceptable and useful gifts. The company buys these devices in quantities and sells at cost to its customers. We reproduce some of the Queens Borough newspaper advertising.

"We bought a large supply of electric portable lamps, and sold them to our customers at $3.75, cost to us," said Mr. Macy the other day. "As a result of mimeograph letters and newspaper advertising we now have several hundred in use. Please do not think my advertising is original. I read everything I can about all methods of gaining publicity and adapt to our company those I consider applicable." Mr. Macy then explained further that every possible avenue was utilized. The back of the envelopes are printed with suggestions as to a broader use of the company's current. Small pasters are attached to the bills and each month some special circular is enclosed with the bills. Specific literature distributed to the company by manufacturers is mailed direct to customers. Enamel card-board signs, "Use Electricity for Light, Heat and Power," are tacked in convenient locations all over the territory and on each of the company's wagons and delivery trucks. A blue and white sign

BETTER LOOK INTO THIS
Light the Streets
And You Will Drive Away
Prowlers, Thieves, Burglars
Additional Incandescent Street Lamps same as those now in use can be obtained for
$20.00, per Lamp per year
These Lamps BURN ALL NIGHT LONG
QUEENS BOROUGH GAS & ELECTRIC COMPANY

FIG. 3.—STREET LIGHTING ADVERTISEMENT.

printed on muslin, "This Building is being wired for Electric Lights. Why not yours?" is displayed on the new buildings. A set of decalcomanie pictures made glad the heart of every school child in Far Rockaway. About twenty-five thousand of these were distributed and many of the pictures are still in existence, though that branch of the campaign is almost for-

gotten in the office. Small vanity mirrors, with the wording "Kill the chill and drive out the dampness," are being distributed to aid the spread of the electric heater.

A few months ago the company began to loan electric flatirons on thirty days' trial, and to-day a steady sale of 10 to 20 a month is being made. Other heating and cooking devices are loaned, especially to bazaars and fairs. In this latter case the company furnishes the raw materials, the devices and demonstrator, and the finished product is sold for the benefit of the object in question. At one of these fairs last summer, waffles were baked and sold "hot from the griddle," and when accounts were settled it was found that the waffles had netted that booth $50.00.

A special rate of six cents per kw-hour is made and a special meter is installed where heating and cooking devices are connected and where a consumer uses the energy for charging automobiles.

Last year a General Electric representative visited Far Rockaway and gave demonstrations of electric cooking. The Queens Borough company rented a separate store for the purpose, equipped it throughout, and sent out invitations to its customers. Many summer residents who had gone home to New York, returned especially to attend the cooking lectures. This proved to be such a success that this year during August and September, Mrs. Katherine Swan will give regular demonstrations in cooking by gas and electricity.

The Queens Borough company does not furnish electric signs free. Every make of sign is sold to consumers at cost and the connections are made free of charge. A large sign is erected over the doorway of the company's office which is turned on and off by means of a clock and flash signs are hung in the windows. These are employed as suggestions to possible users. One man is employed who devotes all his time to seeking new business.

"Yes, I assuredly do believe a central station should advertise," said Mr. Macy in conclusion, "and keep everlastingly at it. Everything tells in the long run. As a result of our activity, the electric branch of our business is way ahead of the gas. We propose now to push the gas, and when it reaches a plane even with electricity, we shall put an energetic man at the head of each department and then watch results. It has always seemed to me that personality enters largely into the management of a central station. A man must know the people and he can keep in close touch through the newspapers. Whenever anything occurs in connection with our work which is of interest to the public, every newspaper publishes a little story in its reading columns. Of course all this publicity is of aid, and is given us because of our personal acquaintance with the people with whom we are dealing daily."

A Clever Advertising Scheme.

Mr. Ludwig Kemper, manager of the Albert Lea Light & Power Company, Albert Lea, Minn., gives over the use of the demonstration gas ranges in the company's office and display room three Saturdays per month to various church organizations and also furnishes all the material they want for cooking or baking. The plan, which is, of course, designed to advertise the use of the gas range, might also be modified to advertise electric appliances by companies not having a gas department. The company's policy of giving all the material needed for cooking, as well as the use of the range and gas, might seem at first sight rather liberal, but, of course, only a limited amount of material can be baked in a day and it is figured that the advertising value of the scheme is worth much more than it costs. The things cooked by the different church organizations are sold by these organizations at the company's office, which, of course, brings in a large number of people to the office that would not otherwise come. By working through these church organizations a large number of ladies are given practical experience with the convenience of the gas range that might not otherwise get it for a long time. Taken altogether, therefore, it is a question whether a less inexpensive and less troublesome plan of advertising could be devised that would give anywhere near as good results in the way of getting people in the town acquainted with the use of these ranges.

A Lesson for Central-Station Managers.

By H. Cole Estep.

Among central station men the country over the justice and economic soundness of the modern system of selling electrical energy on the maximum demand principle is fully appreciated, but the recent events in Minneapolis in connection with the proposed new franchise, for which the Minneapolis General Electric Company is now negotiating with the city council, illustrate very forcibly the woeful ignorance of the general public in all matters connected with rate making in the central station business, and particularly their utter lack of knowledge of the fairness of the maximum demand system. This recent Minneapolis experience also shows how costly this ignorance may become to the central station company by forcing it to accept an unfair and uneconomical system of rates; it also points out the wisdom of carrying out, before it is too late, a comprehensive policy of public education in the principles of rate making.

Early in April the negotiations for a new scale of rates was opened between the city council and the General Electric Company. The company proposed a new schedule, which, while incorporating material reductions in the existing rates, also gave much more prominence to the maximum demand principle. The rates proposed by the company for lighting and small power service are as follows:

DAILY AVERAGE HOURS' USE OF MAXIMUM DEMAND.

	0.5	1	2	3	4	5	6	7	8	10
Proposed rate per kw-hour, cents.	10.0	10.0	10.0	9.0	8.0	8.0	7.0	7.0	7.0	7.0

Special low rates were offered for power taken in quantities from 8 to 10 hours daily.

The public repudiated the proposed schedule; the daily press was filled with protests, particularly against the maximum-demand system; the council committee having the matter in charge was visited by numerous delegations of merchants and business men demanding a flat rate system. It soon became evident that the people of Minneapolis were "dead against" the maximum-demand principle, and being utterly ignorant of the first principles involved in the manufacture and sale of electricity were insisting on a ruinous system of flat rates. The council offered the following substitute for the maximum demand schedule: 0 to 100 kw-hrs., 8c. per kw-hr.; excess between 100 and 200 kw-hrs., 7c.; excess 200 to 300 kw-hrs., 6c.; 300 to 400 kw-hrs., 5c.; 400 to 500 kw-hrs., 4c.

The maximum-demand system was characterized in the public press as "a device to promote unjust discrimination, a scheme solely for the purpose of permitting the company to charge any sum it pleases." Realizing the gravity of the situation, the General Electric Company began the publication of an admirably written series of advertisements explaining in a simple yet thorough manner the principles underlying the making of electrical rates and demonstrating the justice of the maximum demand system. But this attempt to remedy matters by a campaign of public education came too late. At the last meeting of the city council held on May 10 a resolution was unanimously passed, authorizing the conversion of the old city pumping stations into municipal electric light plants. The General Electric Company now has the choice of accepting the flat rate system or of entering into competition with the city. On account of public ignorance the company is destined to lose thousands of dollars through an unfair system of rates.

Perhaps this costly mistake made by the Minneapolis General Electric Company in neglecting its campaign of education until it was too late, may prove to be a valuable lesson to other central station companies. A few hundred dollars spent *at the proper time* in a judicious compaign of public instruction would

have avoided the present difficulty. The justice of the maximum demand system is neither difficult to demonstrate nor hard to comprehend, but the people cannot be made to consider the matter fairly in the midst of a rate-making wrangle. If disaster and financial loss are to be avoided the campaign of public education in rate making principles must be taken up and actively pushed long before the day for proposing the new schedule arrives.

Theater-Curtain Advertising at Sheboygan, Wis.

Previous mention has been made in these columns of the good-natured rivalry going on between the gas and electric light companies in Sheboygan, Wis. The accompanying cut is made from a photograph of the Sheboygan Theater curtain, in which the advertisements of the electric light and gas companies happened to be placed side by side. The gas company came out first with the chained prisoner advertisement, "Don't be chained to old ideas; use gas," whereupon Mr. Gonzenbach,

SHEBOYGAN THEATER CURTAIN.

manager of the Sheboygan Light, Power & Railway Company, immediately came back with the response, "Don't go to prison; use electricity," with a hand pointing at the prisoner in the next space. Incidentally, the advertising on the rest of the curtain is instructive, as showing how much effort is being made by electrical contractors and supply dealers, as there are three advertisements by electrical contractors and supply dealers in addition to those of the central station company.

Headquarters for Baby Milk Warming.

An enterprising central station manager in Minnesota has recently rather unwittingly, although not altogether unwillingly, constituted the company's office and display room a kind of baby feeding headquarters for mothers who are downtown shopping with their infants. It came about in this way. The manager himself had a baby of the bottle-feeding age and his wife, intending to be downtown one day with the baby, asked if she could not come into the office and use one of the milk warmers in the office to warm the youngster's milk while she was downtown so as to save her going home for the process. Of course, he was willing, and soon other mothers hearing of this convenience wanted to know if they could not do the same thing, to which the manager gladly acquiesced, and the central station office is now baby-feeding headquarters for the town as well as a number of other things. It would be hard to get a better advertisement for the money.

"New Business" Department for Central Stations in Cities of 50,000 Population and Under.

Among the papers submitted in competition last year for the Co-operative Electrical Development Association prize was one by Mr. Clare N. Stannard, of Denver, Col., which is of such a high order of merit that it is somewhat surprising that it was not included among the papers receiving prizes or honorable mentions. An abstract of the paper follows:

The first step in establishing a new business department should be a careful selection of a manager. This being done, I would divide the city into territories, containing an average of 5000 people each, or 1250 families. It would then be advisable to sub-divide each territory into two districts, one a residence and the other a business. Thus the territory representative would have an opportunity of working both classes of trade.

I do not favor paying representatives on a commission basis for appliances sold, for the reason that no discrimination is made as to the value of revenue secured through the sale of appliances. Nor do I favor a straight salary basis, for the reason that no inducement is offered for better than average work. I favor the plan of basing compensation upon a combination of a certain fixed salary plus a commission; the commission based upon the revenue secured and the value of the revenue. It is of course recognized that a contract taken, bringing in a certain sum per year, where no expense for construction is necessary, is of greater value to the company than one where a sum equal to the amount received is to be spent for construction work.

A representative should be a **man of good character**; should possess a liberal and broad education and good health. In the selection of representatives, it is wise, if possible, to choose one having the necessary qualifications of a power expert. Another should qualify as a sign, window and outlining expert. Another should possess special knowledge pertaining to illuminating engineering. Men thus equipped can very materially assist the other representatives where special technical or expert knowledge is required. The more knowledge the representatives possess along all lines, including electrical engineering, the greater the efficiency.

The engineering department can render great assistance to the commercial department by giving material aid on all large installations of light and power. Its advice is also of great value when working on isolated plants, and the two departments should work in unison.

SALESROOM.

It should be planned to show all electrical devices and appliances with the proper display of the various kinds of reflectors and glassware designed to properly reflect the light. The effect of decorative lighting should be incorporated; a full supply of staple and fancy electric fixtures should be shown, also different forms of display, window and sign lighting. Electric domestic and industrial appliances should form a permanent part of the office display.

CLERICAL AND SALESROOM EMPLOYEES.

In conducting a new business department it is necessary to have an efficient office force to properly keep the records of

the office and representatives' work. Unless this is done one cannot intelligently analyze the results being secured.

Too great care cannot be exercised in the selection of office salesmen. They should be able to not only sell goods which the consumers ask for, but should possess the ability to create in the simply curious a desire to purchase goods offered for sale.

A bureau of information in the salesroom should be presided over by one of the clerks who would perhaps only devote a portion of his time to it. A list of the vacant houses equipped with electricity should be compiled, with daily revison. A hotel and boarding house directory might be included in this work. Railway time tables should be on hand, and the public should be invited to make use of free telephone service. In fact, many features intended for public comfort and service could be incorporated under this heading.

NEW BUSINESS PLANS COMMITTEE.

This should consist of the active officers of the company, including, of course, the general manager, secretary-treasurer, superintendent, chief engineer, commercial manager, heads of important departments and one or two representatives. This committee should meet at regular stated intervals for the purpose of discussing all new business matters. Suggestions for improvement or work of the department should be taken up and discussed, and it will be found that from the varied interests represented in this committee, many new and original plans will be formulated. Furthermore, a spirit of harmony will be cultivated, which will in turn be transmitted to all departments of the company, a most important factor in the conduct of new business work.

DAILY MORNING MEETING.

This should be presided over by the new-business manager, at which time orders should be given and discussed, reports received from the representatives, giving a record of the previous day's work, and preliminary reports presented, showing the nature of the proposed day's work, matters of mutual interest discussed and verbal reports given by representatives of interesting and important contracts closed. Thorough discussions will result in creating and maintaining interest and enthusiasm. This meeting should be held for a period of one-half hour, usually from 8 to 8.30. It is the universal experience of representatives attending meetings as above described that the time thus spent is of a most profitable nature, and the efficiency of their work has been greatly increased.

WEEKLY EDUCATIONAL MEETING.

This should be held each week. An organization should be formed, having permanent officers, consisting of chairman, vice-chairman and secretary-treasurer. The meeting should be presided over by a chairman, conducted along the lines of parliamentary law. Educational matters should be taken up and discussed, the meetings usually being held for a two hours' evening session. Papers of interest should be presented and discussed. Debates on pertinent subjects should occur. It might be of interest to have two representatives occasionally give an exhibition of how a sale should be made, one acting as salesman and the other as customer. In this way many effective arguments can be presented which will assist those listening in their daily work.

The holding of this meeting gives the representatives an opportunity of discussing many important matters, which on account of limited time cannot be taken up at the morning meetings. In addition to the features just mentioned, it might be well to incorporate in this work some or all of the features found in the scientific study of salesmanship, a course of illuminating and electrical engineering, and a thorough study of all the principles involved in the supplying of electricity for light and power.

DEMONSTRATIONS.

The giving of practical demonstrations is of great value and should not be underestimated. They might be classified as follows: Office, home and church.

At the office or salesroom the various electrical appliances and devices should be carefully and thoroughly demonstrated. In fact, the last two or three days of each discount period it might be wise to arrange for a competent person to demonstrate electricity as applied to the various domestic uses, showing among other interesting things, the chafing dish and various electrical cooking and heating appliances. Neighborhood demonstrations can profitably be given in consumers' homes, allowing the consumer to invite a few special friends. The company demonstrator cooking a meal and using exclusively electrical appliances. In this way very effective advertising may be accomplished.

Church societies are frequently interested in allowing to be given in their church parlors or kitchens a demonstration, at which time various appliances are thoroughly explained and in this way many ladies forming the various church societies become interested and very materially aid in the popularizing of electricity for domestic uses. Oft times in interesting churches in demonstrations, as just described, it is found profitable to present the church society, free of charge, with some one or more electric appliance. Money spent in demonstration work usually proves very effective and is rarely wasted.

DUTIES OF THE REPRESENTATIVE.

In organizing this department and carrying forward the work, it is found advisable to first make a house to house canvass, carefully carding all prospects, upon the completion of which the company possesses itemized and detailed information showing the amount of possible business to be secured. This information, when tabulated, will be found useful and valuable, and is of particular value when the electric company has competition, either in the form of another electric or gas company. When carded, the names and addresses appearing on the cards provide proper lists to be used in sending out advertising.

Representatives should not only be able to take orders, but possess the ability to sell goods. They should canvass all proposed extensions. One of the most important features of their work is the securing of additional consumption from present consumers. All complaint work should be carefully followed up, and reports made to the office of all poor service, making sure that such service is remedied. It is important that they watch all new buildings, making sure that all electrical features are incorporated during their construction, that feeds are of sufficient size to take care of lighting other than the interior system, for instance, sign lighting, window lighting, display and outlining. They should visit architects and builders, interesting them in electricity for both domestic and industrial use.

The holding of business already secured is a most important feature of a representative's work. I deem it unwise to ever discontinue any business simply upon the request of a consumer. It will be found in many instances that much business can be held by a representative calling on the consumer. They can aid the advertising work by supplying the one having charge of the advertising with valuable and detailed information.

SPECIALIZING BY WEEKS.

This is found to be a most profitable way of directing the efforts of the representatives. For instance, on consecutive weeks it is wise to specialize respectively on signs, outlining, window lighting, power, decorative lighting, additional consumption on present consumers, etc. After specializing a week it is well to have a report of the success attending their efforts on this class of work. It is further found that when specializing, representatives concentrate their efforts and, therefore, better results are secured than when working otherwise. It must, of course, be understood that in doing this work the regular line of work must not be neglected. Many prospects are secured during a week of specializing where contracts are afterwards closed.

INCREASED CONSUMPTION OF PRESENT CONSUMERS.

It is profitable to assign men to work exclusively upon increasing the consumption of present consumers, explaining to them and interesting them in the installation of additional

domestic appliances, also decorative lighting and power, thus increasing the company's revenue very considerably.

ADVERTISING.

The work done by the representatives should be assisted by personal advertising and by the lady demonstrator, providing the company has one in its employ.

The new-business manager should have direct charge of the advertising, changing daily the advertisements appearing in the local newspapers.

WAYS TO ASSIST REPRESENTATIVES.

A daily record should be compiled, by the office department, and given to the representative, showing the appliances and orders taken and complaints registered. Thus he is enabled to keep in close touch with all business transpiring in his territory, whether of a personal nature or coming through the office.

It will be profitable for the company to maintain a portable building, in which should be a complete display of electrical appliances.

The new-business committee, as before described, should suggest many ways and means of assisting the representatives. A representatives' room should be maintained in which to hold their meetings, and papers and catalogues should be placed on file for ready reference. Prizes may be offered to regular employees of the company for the one securing the greatest number of tips which are executed, such tips being given representatives, who are thus enabled to close orders which otherwise might not have been secured.

USES OF ELECTRICITY.

Special features may be incorporated in a representative's work as follows: He should occasionally go over his own business territory at night, thus determining where the dark spots are, and seeking to interest merchants in various forms of display lighting; again, demonstrating to the merchant who has a dark store the value of his neighbor's brilliantly illuminated windows or stores. Representatives might occasionally go over their neighbors' territories at night, reporting at the next morning meeting suggestions whereby he would seek to improve the conditions found.

The giving of souvenirs is frequently of assistance in increasing the company's business. An expert window dresser might, at certain seasons of the year, be profitably employed, dressing and arranging, free of charge, windows illuminated by electricity; in this way seeking to interest merchants in additional installations of light, also merchants not heretofore advertising by means of electricity.

It should be the aim of all commercial men to secure the hearty co-operation of all the employees, for it will be found that the office, station and line men can frequently assist the representatives in securing business. Representatives should constantly be on the lookout for ways and means of increasing the company's revenues.

RESULTS.

Results can and have been secured more than compensating many companies for the money spent in the new business department. Specifically speaking, through this department the consumption per kilowatt per inhabitant can be materially increased. This is true also of the consumption per consumer, and the consumption per 16 candle-power lamp connected to the system.

This department is an important factor in reducing the manufacturing cost per kilowatt, also reducing the costs per kilowatt delivered to the consumers, which necessarily increases the company's profits. The department should be an important factor in increasing the daily load at all times except at the peak, thus lessening the amount of current losses, reducing the cost per kilowatt for manufacture and distribution, increasing relatively the profit.

It is further found that each prospect secured serves to assist in developing new ones. It will further be found that the field is inexhaustible. While in some instances the costs to secure new business the first year seems high, the fact must be taken into consideration that the business thus secured remains with the company for years, and is of no further cost. It is not an unusual thing for a new business department to receive in revenue, the first years, three or four times the original investment.

Co-operative Lighting of Streets by Merchants.

BY FRED. G. BOLTON.

Houghton, Hancock and Calumet are the principal towns served by the central station of the Houghton County Electric Light Company. Each town is practically of the same size and layout, and friendly rivalry exists between the merchants of each, not only as to the adoption of the best methods of advertising, but also as to the best and most up-to-date methods of properly illuminating the main thoroughfare of their respective towns by night. This rivalry may be the sinew of the success of co-operative lighting of streets by merchants in this county, but be that as it may, I feel perfectly justified in saying we have at Hancock the most unique and beautiful method of street illumination of any town of equal size in this state.

In the year 1903, Hancock took upon itself the task of entertaining the firemen of the Upper Peninsula of Michigan, and accordingly different committees were appointed to arrange for their entertainment. One of these committees, known as

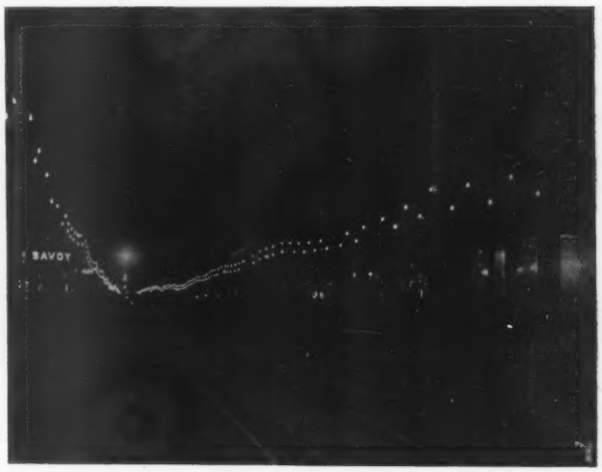


FIG I.—NIGHT SCENE ON A HANCOCK STREET.

the "Decoration Committee," got together for the purpose of properly illuminating their main thoroughfare and city hall, and with the advice of the officers of the Houghton County Electric Light Company, approved and adopted the following plan:

The stringing of two strands of wire one above the other on each side, from one end of the business section of the main street to the other end; the placing on these strands of wire, incandescent lamps of four candle power, four feet apart, having the lamp on the top wire placed directly over the center of the space between two lamps of the lower strand, so that virtually the street was lighted by electric bulbs placed two feet apart, on each side its entire length. The tower and entire front of the city hall was also wired for numerous incandescents. When the work was completed and the current turned on it presented a novel and pretty sight. Although this arrangement was only intended to be temporary, so well did it take with the merchants, that after the fair was over, they clubbed together and were successful in getting enough subscriptions to warrant having the lights turned on each Saturday night. So much for Hancock.

Houghton was not going to be outdone by its neighboring town and its council began to get busy along similar lines. A committee was appointed by the mayor to take the matter in hand. This committee waited upon the management of our

company, who agreed to light two blocks of the main thoroughfare similar to that of Hancock as a demonstration. This much done, the merchants wanted more, and the committee got busy upon its subscription list, and were successful in raising sufficient to light the business section of their main street its entire length on each side with incandescent lamps of four candle power, placed four feet apart, not only on Saturday nights, but each night of the week.

Calumet followed in the footsteps of Houghton. Seeing that these two towns were somewhat ahead of them, Hancock took greater courage and brought the matter of having this extra illumination of their main street each night, instead of Saturday night only, before their council, who in turn appointed a committee to take up a new subscription list among their merchants. This committee, with the aid of our company (which by the way took kindly interest in it also) were successful in raising all but $40 per month of the amount required, in order to have our company reconstruct the line, placing the lamps four feet apart instead of two as heretofore, and burning each night of the week. Not undaunted, the council at its regular meeting

FIG. 2.—DECORATIVE STREET LIGHTING IN HANCOCK.

appropriated $40 per month towards this undertaking to meet the deficiency, and now Hancock, Houghton and Calumet enjoy having their main streets as light as day, each and every night of the year.

The question may be asked: Is this form of street illumination a profitable source of income for the central station? In our case, I answer "Yes." We derive a yearly gross revenue of something like $5,000 per year, or in plain electrical terms, 12 cts. per kw-hour for energy consumed. This gross income with the cost of operation reduced to a minimum is profitable to our company, and although we have only a yearly contract for the lighting of these lamps, yet so well pleased are the merchants that I firmly believe that the contract will be renewed from term to term for a number of years to come. As a reason for this belief, I will state that Houghton, at the present time is entertaining the advisability of extending this form of street lighting to residental streets as well as the business section, and if Houghton should do this, the other towns are sure to follow. And now may come the question, How can this be accomplished in other towns? The same as it has been accomplished here. Believe yourself, that you have got a good proposition to give the people and then prove it to them, by lighting a few blocks at your expense as a demonstration, and I believe if you do this your success in the venture is assured.

We must show our goods to the buying public before we can sell them, and this is as true in selling electricity as in any other mercantile line. I send herewith Figs. 1 and 2, snap shots of Quincy Street, Hancock, taken after the electricity is turned on at night.

The Utility of the Central Station Bulletin.

The article published in our issue of April 6, entitled "Is the Bulletin a Result-Bringer?" has created considerable discussion among persons interested in central station sale of current. We are in receipt of several communications bearing on this subject. Mr. La Rue Vredenburgh, superintendent of the exhibition department of the Edison Electric Illuminating Company of Boston, gives data in regard to the experience of his company in publishing "Edison Light": The first number was issued in May, 1903, and for upwards of two years the issue was confined to 5000 copies a month, which were distributed to architects, contractors and builders, engineers, real estate men and publishers. At the expiration of that time it was decided to increase the circulation to about 21,000, including all the customers of the company, at the same time enlarging the publication to a 16-page booklet.

About a month ago the question was raised as to the advisability of continuing sending out the same quantity, and all the members of the general agent's department, with heads of other departments, were called together, and an expression of opinion was asked as to the advisability of cutting down the mailing list to about its original amount, or continuing it as it was. The vote on the part of those present was almost unanimously in favor of continuing the plan then in operation, namely, sending copies to all the customers of the company each month. Those representatives who came into immediate contact with the public expressed their opinion unhesitatingly in favor of the bulletin, saying that they considered it a decided business bringer. Mr. Vredenburgh says: "My position, as superintendent of the exhibition department, of course enables me to meet the public quite generally, and I constantly hear very favorable expressions regarding this publication, and while, as you know, there is great difficulty in tracing direct results from this sort of effort, I am thoroughly satisfied that the expenditure involved is fully justified."

Speaking for the advertising department of the Public Service Corporation of Newark, Miss Frances Nelson, editor of its "Light & Power," says: "We feel that 'Light & Power' is fulfilling the mission for which it was started. It never was intended for a direct business bringer but has been and is now an educational proposition. To this end we have always made it local to our field. When we want to show signs, they always are New Jersey installations. When we want to prove the benefits of electric power, we use as examples the power installations of our own customers. It is the same in all other branches. We do not believe in wasting our ammunition on abstract generalities when we can show John Jones what Harry Smith is doing. Requests to be represented in 'Light & Power' are frequent. With these we invariably comply, a two-fold result being assured; a pleasanter business relation and an increased interest on the part of the customer. That the bulletin is doing an educational work is evidenced by the fact that our solicitors very often find full files preserved.

"Aside from the regular general distribution of 10,500 a month, we frequently specialize them. For instance, if we show a particularly good dental installation we mark and mail copies to the dentists in our territory. The same thing is done with all the other particular interests we wish to reach. But our bulletin does not go simply to prospective customers. It goes to those who are already using our current. We want to keep up our educational process, for there is a possibility that wherever current is used to-day more may be sold to-morrow. What we think of the value of such a medium is evidenced by the fact that with the July issue it goes into its fourth volume and since its first edition it has grown from eight pages, printed in one color, to its present size of sixteen done in two colors with especially designed covers. But we don't view it as an immediate business bringer; we consider its cumulative results."

H. K. Mohr, manager of the advertising bureau of the Philadelphia Electric Company, writes: "Is the central station

bulletin a 'house organ,' or is it simply published as auxiliary advertising, with no other definite purpose than that of blowing the company's trumpet as loudly and expensively as possible? In the latter case, no matter how handsomely printed or elaborately illustrated, will not the constant iteration and reiteration of the interesting fact that the company is really obtaining its share of new business pall on the recipient of the pamphlet, and, in any event, is the constant summarizing of private plants shut down and new electric signs installed sufficiently valuable and interesting advertising upon which to spend anywhere from $2,500 to $50,000 per annum?"

The officials of the Philadelphia Electric Company did not sanction the publishing of a bulletin, Mr. Mohr states, until they were convinced that such a publication had a valuable function to perform as a "house organ." A "house organ" is primarily intended for the existing customers of any company, and is used only in a secondary sense in advertising to the consumer, and that is the Philadelphia Electric Company's theory.

They believe that the primary and most important mission of the bulletin is to increase and cement the cordial relationship existing between company and customer; to endeavor to make the understanding between company and customer as complete and thorough as possible; to acquaint the customers, in all frankness, with everything which can be of any possible interest in its effect upon them as the purchaser or upon the company as producer.

Their theory is that it should be driven home to the customer that there are no secrets in the generating and selling of electricity; that there is nothing arbitrary or unusual about it; that it is a plain business proposition, no more involved than the every day purchase and sale of any ordinary commodity.

With this thought in mind they only publish the bulletin "every little while for the information and in the interest of their customers." In other words, when there is anything to say of interest, the bulletin is published. They claim that a satisfied customer is of considerable more value as an advertisement than a new customer obtained as the result of advertising.

Every issue contains at least one leading article upon a subject which would be of particular interest to any of their customers, such as a simple description of the working of a meter and the reasons for its accuracy, together with ease of testing, etc.; methods of economizing in the use of electric power and light; an exposition of the various free services rendered and how to obtain the same in the least troublesome manner, and so on.

The editorial columns are used from time to time to give official expressions of opinion of the executive regarding matters affecting the public utility company and its policy. Published in this way they believe that the bulletin stands a chance of remaining of interest to the customer, and that it also saves to the company many of those consumers who do not take the trouble to complain when dissatisfied with the service, but suddenly notify the company to discontinue furnishing current. In the February number of their bulletin they called attention to the fact that this class of "disconnections" had been greatly reduced since the publishing of the bulletin, in fact the percentage of lamps disconnected to lamps connected, during the year 1906, showed a decrease of 17 per cent over the year 1905; and to quote further: "Taking the statistics of 1905 as a guide, the percentage of lamps disconnected to lamps connected is lower in the case of The Philadelphia Electric Company than that of any of the large lighting companies in the country. We take this fact as an indication that the traditional friendship existing between this company and its customers has become closer and more intimate during the past year."

The bulletin question is certainly one of broad interest to the central station manager. The consensus of opinion is that he must advertise, must bring the personality of his company into close touch with the consumer, and whether or not he publishes a monthly bulletin, is a matter to be determined by the special conditions in his own field.

LETTER TO THE EDITORS.

Reading Lamps.

To the Editors of Electrical World:

SIRS—The question of reading lamps for use in residences has been somewhat of a thorn in the flesh of central station managers for many years, and it is not a matter for comfortable reflection that in many electrically lighted homes the oil reading lamp still has a place and is regularly used, although electric light is used everywhere else in the house. There are two reasons for this condition of affairs. The great majority of electric chandeliers in use to-day are utterly unsuited to use as sources of reading light. This has forced the use of electric portable lamps, and the great majority of electric portables are decorative rather than useful appliances. As the reading lamp is the one which should bring the central station more income than any other one lamp in a home, the question is certainly one of more importance to a central station company than might at first be thought. To begin with, what is the trouble with the majority of electric portable lamps.

The answer is that most are constructed in defiance of the laws of light and of common sense, and if perchance they happen to be of proper shape to throw light around the edges of the table where it is needed, a long fringe is hung around the edge to obstruct what little useful light might otherwise get out. On the other hand, our old friend, the kerosene lamp, with the deep opal dome reflector is most efficiently equipped to put the light where it is needed around the reading table. The most efficient forms of electric portables have deep dome-shaped reflectors following closely in shape the opal dome used for so many years on gas and kerosene lamps. To add to the handicap of the electric portable, it has frequently been equipped with a clear glass bulb lamp. The light from a clear incandescent lamp comes from a very small filament, while that from a kerosene lamp comes from a large flame, with the result that the glare from the highly glazed papers common now is likely to be much more annoying from the clear bulb incandescent lamp than from the kerosene flame. The obvious way to remedy this latter difficulty is to use a frosted bulb incandescent lamp, so that the light will come from a larger surface.

There will probably always be considerable difference of opinion between individuals as to the relative desirability of the illumination obtained for reading purposes from a table lamp, as compared with that obtained from a properly equipped chandelier. By properly equipped chandelier is meant one having at least one socket for a reading lamp pointing straight down and equipped with a fairly concentrating opal or prismatic reflector which will give a good illumination for reading purposes anywhere under the chandelier.

Those favoring thus placing the reading lamp on the chandelier argue that it does away with the necessity of sitting close up to a table and holding a book near the lamp to read; that the efficiency is practically as high or higher than with a table lamp and that the table lamp is an inconvenience and a relic of kerosene and tallow candle days which can be well relegated to the scrap heap with the introduction of a lamp which does not have to be set on a table, but can be placed up out of the way. They also maintain that with the reading lamp on the chandelier there is enough general illumination of the room for ordinary purposes; whereas with a table lamp frequently additional general lighting is necessary. Those who champion the table lamp argue that a well-lighted space around the table with the rest of the room in semi-darkness gives a cheerful, cozy effect that cannot be obtained by any chandelier lamp, and that with the light coming from one side of the reader there is likely to be less annoyance from the glare from glazed paper than if the light is coming from above. The argument as to the cozy effect is a matter of personal opinion, upon which argument is useless. There is undoubtedly some force in the contention that reflection from paper can be more annoying with light from above than from one side, although that is

largely a matter of the angle at which the reader holds the paper, and, as a rule, is instinctively taken care of by the reader. The purpose of this letter is not to take sides on this question, but simply to call attention to the numerous tribulations caused to the electric light industry by improper design of reading lamps and to point out where lie the paths of escape for the future.

CHICAGO, ILL. S. N. GARRISON.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Determination of Losses in Motors.—C. F. SMITH.—An illustrated paper read before the Manchester Section of the (British) Institution of Electrical Engineers. The author considers at some length the application of the retardation method of determining the losses in motors with and without auxiliary flywheels. After dealing with methods involving the use of a flywheel as applied to continuous-current motors, the author discusses tests of alternating-current induction motors. After classifying the different losses met with, he describes a number of methods by which each group of losses can be measured. —Lond. *Elec. Eng'ing*, April 11, 18 and 25.

Lamps and Lighting.

Comparative Costs of Gas and Electric Lighting.—E. G. KENNARD.—A paper in which the author first gives the average prices of electric energy and gas in London for lighting purposes during the past 16 years. The rates for electric energy have steadily declined until in 1906 they were nearly one-half of the value in the year 1891, while the price of gas has decreased only some 3 per cent during the same period. This indicates that the price of gas has almost reached its minimum value, while further reduction in the rate for electrical energy may be expected from the adoption of larger power stations, etc. The author briefly discusses the various items of cost which enter into production of light, and then gives a summary of the different incandescent lamps and arc lamps now available for commercial use with tables on their first cost, power consumption, etc. He then discusses the cost of gas lighting. He finds that for from 40 candle-power to 60 candle-power the best electric lamps, like tungsten, osram, are more expensive than Welsbach and inverted gas mantles and that the price of energy would have to be reduced to about 5 cents per kw-hour in order to make the cost of electric lighting equal to that of gas using gas at 66 cents per thousand cu. ft. However, it is impossible to obtain efficient gas lighting for lamps below 40 candle-power, while low-candle-power efficient electric incandescent lamps are available. The author finds that for small candle-power lamps, where low voltage is obtainable, electricity is cheaper than the gas. Where the effective illumination of large areas is required, the flaming arc lamp is the cheapest lamp to employ. "From the trend of recent electric lighting developments," in the author's opinion, "the ideal electric supply for the consumer is continuous current at a pressure of about 60 volts. On this voltage arc lamps can be operated singly without needless waste of power in resistance beyond that required for regulation, and also metallic-filament lamps of from 10 candle-power to 16 candle-power can be used. Unfortunately, a continuous current 60-volt supply is only practicable where a private generating or converting plant is installed, 100 volts being the minimum pressure used on large continuous-current networks. An alternating-current supply is, on the whole, preferable to continuous current at 100 volts for private lighting, as any required voltage can be obtained by the use of transformers. The chief objection to running a large number of small transformers on lighting mains is the exceedingly low power factor obtained, especially at light loads." The author concludes that many existing electric lighting plants could be improved by using the modern lamps.—Lond. *Elec. Eng.*, April 19, 26 and May 3.

Illumination.—J. D. MACKENZIE.—An article discussing some general problems of illumination. The following comparative figures of coefficients of reflection of different materials are given. Highly-polished silver 0.92, highly-polished copper 0.60, white blotting paper 0.82, chrome yellow paper, 0.62, plain deal (clean) 0.45, light pink paper, 0.36, yellow painted wall (clean) 0.40, emerald green paper 0.18, black paper 0.05, black cloth 0.012, black velvet 0.004. In domestic lighting it is suggested that high-efficiency metallic-filament lamps should be arranged in straight tubes, backed by reflectors and placed along behind a deep frieze molding; the principal intensity of illumination should come from one definite direction, preferably from the direction in which daylight enters; the ceiling from which the diffuse reflection is desired should be of a white matt surface, and walls should preferably be of light tints. These high-efficiency lamps could be arranged in lengths of, say, 12 ins. giving four in series on from 200 to 250 volts, the total number of lamps being installed according to the highest intensity of illumination desired, and such switching arrangements made as would enable two or more combinations to be employed whereby this intensity might be reduced.—Lond. *Elec. Rev.*, April 26.

Incandescent Lamps.—J. SWINBURNE.—A discourse at the Royal Institution on incandescent illuminants. The author first discussed the incandescent gas mantle and its theory and then spoke of the Nernst lamp and of recent improvements in metallic filament lamps. The "zircon" lamp was on exhibition and was understood to be made of zirconium and tungsten; probably the filament is a zirconide of tungsten. Lamps for 200 volts have been made, a matter of the greatest importance from a distribution point of view in England. The 100-volt lamp shown at the lecture had six separate loops of wire mounted in series. A recent improvement is to provide an extremely light spring to keep each filament taut and thus to render the lamps capable of burning in any position. It is probable that tungsten or a compound will provide the high-efficiency lamp of the future. An illumination of one candle per watt is hoped for, but at the same time to provide a filament having a resistance of 500 ohms fine enough to give 20 candles with 20 watts will require a very great effort of inventive skill. —Lond. *Elec.*, May 3.

Arc-Lamp Carbons.—C. RICHTER AND H. HAESER.—An illustrated article in which the authors discuss the disadvantages of arc-lamp carbons lacking in absolute straightness. They describe an instrument which enables one to test the straightness and also to measure the length, the diameter and the form of cross-section.—*Elek. und Masch.*, May 5.

Determination of Mean Horizontal Candle-Power.—F. UPPENBORN.—A translation in abstract of his recent German paper giving a comparison of different methods for determining the mean horizontal candle-power of incandescent lamps.—Lond. *Elec.*, May 3.

Power.

Troubles with Direct-Current Machines.—W. H. EAGER.—In an article entitled "Experiences on the Road," the author describes some troubles of direct-current machines and their remedies. They have to do with sparking at the commutator, broken leads, irregular neutral point, grounded armature, short-circuited or reversed coils. Troubles may be prevented to a large extent by properly heeding such precautions as the following: Machines should be located in dry places, free from dust and dirt. If the latter is impossible, an enclosed machine should be used. New machines shipped during damp or cold weather should stand several days before voltage is applied to them, so that they may be dried after the sweating to which they are liable. All connections should be tight, brushes properly fitted to the commutator, and oil rings working properly.

After a machine is started it requires supervision. Keep it clean. A cotton cloth neatly wrapped on the end of a flat stick is better than waste on the commutator. To polish a commutator use sandpaper, never emery cloth. An air blast readily disposes of dust. Keep oil away from parts that are not supposed to be oiled. Oil rots and destroys the insulation. Never let a machine spark. If it does, stop at once and locate the trouble, but do not let a machine keep on sparking day after day. It eventually means a new commutator and before that an endless supply of brushes.—*Electric Journal*, May.

Electric Equipment of a Dock.—An illustrated description of the electric equipment of the new dock at Clydebank. The original intention of the Clyde Navigation Trustees was to employ entirely hydraulic machinery, but after experimenting with electric cranes and making full inquiries as to the working of similar machinery elsewhere, they realized the advantages of the electrical over the hydraulic machinery and it was finally decided to employ electricity exclusively as a motive power. The electrically-driven coal hoists are the first of their kind in England, and an important advantage is the avoidance of troubles due to freezing, which caused much delay and loss last winter in the case of some hydraulic coal hoists. Two of the hoists are already in working order, one of which is capable of raising a load to a height of 50 ft. and the other to a height of 60 ft. Each is designed to deal with 1000 tons of coal per hour, and under normal conditions of raising a total gross load of 32 tons to a height of 50 ft. in 30 seconds and of tipping a wagon up to a maximum of 45 degrees in six seconds. The whole of the machinery is placed at the top of the hoist, and the controlling gear is so arranged that the cradle can be automatically stopped at any predetermined position, so that any possibility of overwinding or overtipping is obviated. In connection with each hoist is a tipping turn-table, 18 ft. in diameter, which can be tipped or tilted upwards, so as to compel the wagon standing on it to run off the table into the hoist cradle. A feature of the equipment of the power house is the use of a flywheel on the generator shaft, to deal with the intermittent load caused by the working of the coal hoists.—Lond. *Elec. Eng'ing*, May 2.

Peat as Fuel for Central Stations.—A note stating that the Siemens-Schuckert Works are at present engaged on the establishment of an electric lighting and power station in the vicinity of Aurich, East Friesland, which is intended to furnish an electricity supply to a number of localities in that region, and the utilization of peat as fuel is to play a part in connection with the scheme. "In addition to ordinary coal-fired boilers, the station is to be equipped with a special type of boiler, in which peat will be consumed without the tedious method of preliminary drying of the material or any other system in which a large amount of time is lost before firing the furnace."—Lond. *Elec. Rev.*, May 3.

Suction Gas Plant Versus Steam.—An anonymous article giving comparative figures. It appears that when all conditions are duly stated for equal load factors and size of unit, the cost of energy from suction-gas plants will be in the neighborhood of one-half that from steam power, in the smaller units, while as the size of the unit increases, the advantage of the suction plant falls off in the comparison, though owing to the higher heat efficiency of the internal combustion-engine and producer plant, associated with other advantages of the system, the suction plant enters into competition with the highest class of steam engine. As the size of unit becomes fairly large, the initial cost of the gas plant becomes approximately equal to that of economical high-class steam engine plants with accessories, when the question of cost turns mainly upon thermal efficiency, in which that of the gas plant is about twice that of a steam installation.—Lond. *Elec. Rev.*, April 12.

Gearing Motors to Machinery.—W. L. SPENCE.—A paper read before the Institution of Engineers and Shipbuilders in Scotland on the mechanism of power transmission from electric motors. He considers in detail the pros and cons of various methods for gearing electric motors to the machinery which they are to drive. A large number of illustrated examples are given. The paper deals with belt-drives, direct-coupled drives, flexible-shaft drives, direct-coupled vertical-shaft drives, spur-wheel drives, idler-wheel drives, various forms of self-contained reducing gears, planetary gears, chain drives, worm gearing and continuously variable speed devices.—Lond. *Elec. Eng'ing*, April 18 and 25. In the discussion which followed, W. B. Hird showed some curves on the give-and-take of energy between the motor and the flywheel of electrically-driven shearing and punching machines. W. W. Lackie described a form of friction gear in successful use in connection with some electrically-driven pumps at Glasgow.—Lond. *Elec. Eng'ing*, May 2.

Wind Power.—W. O. HORSNAILL.—The first part of an article in which the author considers the possibility of utilizing wind power for the electric lighting of country houses. The necessity of storing energy is pointed out and some account is given of actual installations. The article is to be concluded.—Lond. *Elec.*, May 3.

Traction.

Electric Traction on Railways.—P. DAWSON.—A continuation of his article giving some general considerations. Probably the most important property of all possessed by electricity is the rapid acceleration that can be obtained. A diagram gives acceleration curves for various steam and electric railways. On account of the rapid acceleration a much higher average speed may be obtained. Another important benefit resulting from the use of electric traction is the diminution of the present difficulties due to the lack of accommodation in terminals. It should be possible to save at least three or four minutes on each train entering or leaving a terminal.—Lond. *Elec.*, April 26.

Installations, Systems and Appliances.

Electric Station Statistics in Austria.—L. ROSENBAUM.—An article giving statistical data on Austrian electricity works. Up to the end of 1905 there were 446 stations which supplied energy to 1087 towns. There were three more works which are supplied by electrical energy from central stations beyond the frontier. During 1906 there were opened 45 new works so that there are at present in Austria 494 electricity works. Data on systems and capacity are given in the table.

System.	No. of Stations.	Kw. of Machines.	Kw. of Batteries.	Total kw.
Direct current with storage batteries..	202	30,220	8,650	38,870
Direct current without storage batteries.	116	5,100	——	5,100
Single-phase current	13	30,270	——	30,270
Two-phase current	5			
Three phase current.....	103	86,550	2,630	89,180
Combined 3-phase and direct current..	8	4,150	680	4,830
Combined single-phase and direct current	1			
Monocyclic system	1	520	80	600
	449	156,810	12,040	168,850

138 of the direct-current works use the two-wire system, 179 use the three-wire system, and one plant uses the five-wire system. Of the total 446 works, not less than 221 use water power exclusively, 68 use both water power and steam, 106 use steam exclusivly, 23 gas, 5 steam and gas, 20 water and gas, and 3 steam, water and gas. The aggregate capacity of all steam engines is 126,900 horse-power, that of the water turbines 86,700 horse-power and that of the internal combustion engines 4500 horse-power. Only eight works have a capacity above 5000 kilowatts, 24 have a capacity between 1000 and 5000 kilowatts, 25 between 500 and 1000 kilowatts, 137 between 100 and 500 kilowatts, and 252 less than 100 kilowatts. The distribution voltage is between 100 and 150 in 40 per cent of all plants, 150 in 28 per cent of all plants and 220 in 30 per cent. In this respect the situation is similar to Germany, where a consumer's voltage of 110 is also prevalent, while in Great Britain double the voltage is more common. Diagrams are given showing the development of the stations from year to year and also a comparison of Austria with Germany. In alternating-current works a frequency of 50 is used in 80 works, a frequency of 42 in 34 works and frequencies of 21, 23, 40, 45, 55, and 60 in 15 other works. With respect to tariff for lighting 195 works use a unit rate per kw-hour and meter the energy, 156 use a flat rate, 82 have both systems and 8 have a double-tariff according to the hours in the day or seasons in the year.

With respect to the rates for motors, 190 works charge for the energy metered on the basis of a unit price per kw-hour, 65 works have a flat rate and 54 use both systems. The unit price of the kw-hour for lamps varies between 4 cents in Triest and 20 cents in St. Wolfgang and may be assumed to be on the average 12 cents. The flat rate for lighting varies between 10 cents and 32 cents per cp-year, the average rate being 20 cents. The unit rate per kw-hour for motors varies between 0.7 cents in Hohenfurt and 16 cents in Bad Gastein, the averate rate being 6 cents. The flat rate for motors varies between $3 per hp-year in Innsbruck for small motors and $100 (10-hour operation) in Bielitz, while most works have an average rate of $24 to $30 per hp-year.—*Elek. und Masch.*, April 28.

Russia.—Some notes on electric lighting in Russia in 1906. On an inquiry on the electric energy consumption in Russia with the exception of Finland, replies were received from 132 central stations and 5326 private electric plants. Four hundred and eighty-one million six hundred thousand kw-hours were consumed in 1905, of which a little over 100,000,000 was supplied from central stations; 221,600,000 kw-hours were used for lamps and 260,000,000 for motor purposes. The consumption of gas for lighting was 79,300,000 cubic meters, and for gas engines 14,610,000. While gas is produced almost completely in central works, electric energy is mostly generated by the consumer himself. The following figures give an idea of the extent of electrical industries in Russia in 1905: There were 5458 electricity works with 8348 dynamos, the capacity of the latter being 301,912 kilowatts. The useful electrical energy was 481,595,100 kw-hours, which is about 3.44 kw-hours per inhabitant. The corresponding latter figure is 54 in St. Petersbur, 34 in Moscow. The analogous figures for other European capitals are 40 for Berlin, 26 for Hamburg, 8.2 for Copenhagen, and 7.1 for Stockholm.—*Elek. Zeit.*, May 2.

Livet Station.—J. Reyval.—The hydro-electric station at Livet is located on the Isere, some distance from Grenoble. A waterfall of the Romanche is utilized. Originally this plant produced energy for the manufacture of calcium carbide. For this purpose it was equipped with five groups, each of 1000 kilowatts, producing single-phase currents at 75 volts, and with two exciter groups of 150 kilowatts. The electrical energy furnished by these generators is now employed for the manufacture of aluminum and for other electrometallurgical work. Later on a second plant was erected to furnish electrical energy to the city of Grenoble. This new plant has recently been opened. It comprises three generating sets, each of 2500 to 3000 horsepower. Three-phase currents at 3500 volts are generated and the voltage is raised to 26,000 or 32,500 for transmission. An interesting feature of the installation is the speed regulation by a central regulator of the Bouvier system for all turbines, while each turbine has also its own regulator.—*L'Eclairage Elec.*, May 4.

Relays for the Control of High-Tension Switch Gear.—C. C. Garrard.—The use of the totally-enclosed oil-break switch as circuit-breaking apparatus in high-tension switchgear is standard practice. If this be automatic in action, in only a few cases can it be controlled by a simple solenoid with an instantaneous release. In by far the large majority of cases a relay is used for controlling the circuit breaker. When the circuit controlled feeds bus-bars, a reverse power relay must be installed. If the circuit takes current away from bus-bars, inverse time-element maximum-current relays are necessary. These latter must be capable of adjustment both as regards time element and operating current. The reverse power relay should also have a certain time element. The author first discusses maximum inverse time-limit relays and points out that means should be provided for timing circuit breakers so that only that one nearest the scene of the electric disturbance will be operated, so as to keep the effects of such disturbance within the narrowest possible radius. A diagram is given of a two-phase plant containing three maximum time relays in series and it is pointed out that these three relays should always operate in a distinct order of succession and that this sequence must hold good under all conditions no matter how great the overload. This will be impossible with designs in which for a certain high load the time becomes zero and the device becomes an instantaneous-action cut-out without any time element. To avoid this, the second-ampere curves of the relay should be asymptotic at large overloads to certain definite times. If these times are known the relays are so installed that they operate in the desired sequence whatever may be the overload. In the case of the relays described by the author, the reason of the existence of a minimum time is that the relays

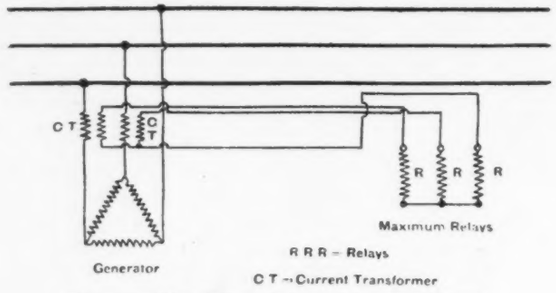


FIG. 1.—TRANSFORMER AND RELAY CONNECTIONS.

operate on the induction principle and the minimum time corresponds to synchronous speed of the rotor. With moderate overloads the disk revolves below synchronism, due to the damping. By suitable dimensioning of the parts, any minimum time can be made to correspond to synchronous speed of the disk. The author then discusses the connections of maximum current relays on three-phase circuits. On a three-phase circuit having the neutral point earthed (four-wire circuit) a triple-pole relay must be used, fed by three current transformers, one being in each phase. On a three-wire, three-phase circuit—*i. e.*, neutral point not earthed—only two current transformers are required, by reason of the fact that the current in one phase is always equal to the vectorial sum of the currents in the other two. Strictly speaking, it follows that a double-pole relay is sufficient protection for such a circuit. For mechanical reasons, however, it is better to install always a three-pole relay, because in the event of a short coming on which affects only two of the phases it is safer to have a relay in each phase since one of them will surely operate. This argument does not, however, apply to the current transformers, and there is no reason to install more than two of these. The current transformers do not contain any moving parts and from the nature of things are much less liable to get out of working order than relays. The scheme of connections to be recommended here is shown in Fig. 1. The author then discusses current transformers for

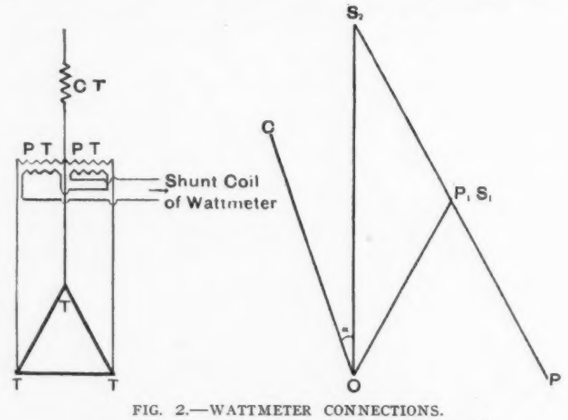


FIG. 2.—WATTMETER CONNECTIONS.

operation of relays and reverse power relays and the connections of the latter. For three-phase generators in which the neutral point is not brought out, a double-pole reverse relay is sufficient. Should, however, the neutral point of the generator be grounded, a triple-pole relay must be used, and it is necessary to pay particular attention to the connections. This will be seen from the following experiments made on some 1500-

kw three-phase 10,000-volt generators, the neutral points of which were earthed. Each machine was equipped with a single-phase wattmeter connected as in Fig. 2, where *TTT* are the terminals of the generator; *PT, PT,* potential transformers; *CT,* current-transformer feeding series coil of wattmeter; OS_1 and OP_1, voltages on secondary and primary of one potential transformer; S_1P and S_1S_2, voltages on primary and secondary or secondary potential transformer; OS_2, voltage applied to shunt terminals of wattmeter; *OC,* current in series coil of wattmeter when the power factor of the main current equals cosine. In order to use the above system of connections, it will

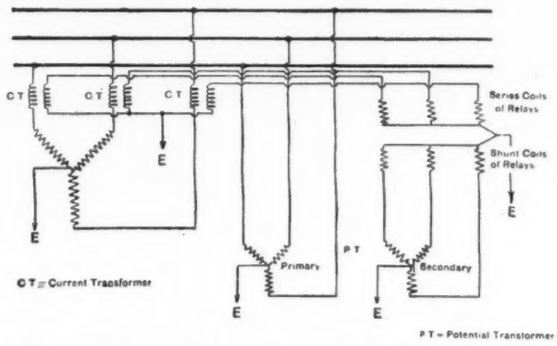


FIG. 3.—RELAY CONTROL OF HIGH-TENSION SWITCH GEAR.

be seen that the secondary of one of the potential transformers must be reversed. The periodicity was 50. Two machines were run in parallel on a water rheostat load, and the excitations were adjusted for minimum current at full voltage. On shutting off the motive power of one of the generators and running it as a synchronous motor the wattmeter in the motoring machine reversed, indicating that the machine was absorbing power. The excitation currents of the machines were now varied, that of the motor being decreased and the generator increased. Under these conditions an abnormal action of the wattmeters was to be observed. When the cross current between the machines had reached a certain magnitude, the wattmeter on the motoring machine began to read forwards again, as if it were generating, although it was, of course, running as a motor. When the neutral point connections on the generators were removed, the abnormal action ceased entirely. The explanation given by the author is as follows: In each leg of a three-phase alternator voltages are induced at frequencies other than the fundamental frequency. The most important harmonic is most often the third. A voltage corresponding to the third harmonic cannot exist between the phase terminals. When the neutral points of the machines are not earthed, therefore, it is impossible for any transference of 150-period energy to take place from one machine to the other. As soon, however, as the neutral points are connected, the three-phase connections act together, as one conductor and the neutral connection as the other, and there is a flow of 150-period power and current which will not be indicated on the wattmeters. With a certain difference of excitation the high-frequency current had reached such a value that the energy transferred by this means was sufficient to drive the machine, and from that point outwards it began again to generate 50-period power. In fact, the machine was running as a phase changer, receiving higher frequency energy by way of the neutral and giving it out at its terminals at 50 periods. Since these experiments proved the possibility of a reversal of power into a machine, which has its neutral point earthed, at a higher frequency than the normal, care must be taken that the reverse power relays are connected so that they are influenced by energy passing through a machine by way of its neutral point. The connections shown in Fig. 3 are, therefore, recommended, the rule being expressed as follows: The reverse relay on a three-phase generator having its neutral earthed must consist of three single-pole reverse relays, and the series and shunt coils of these must be connected in star. The potential transformers feeding the shunt coils of the relays must also be connected in star on both the primary and secondary sides, as also should be the secondaries of the three current transformers. All star points should be earthed. Finally the connections for three-phase reverse power relays are discussed when the neutral point is not earthed.—Lond. *Elec. Eng.*, April 26.

Power Factor.—W. E. SUMPNER.—An article in which the author first points out that the fact of the power factor of an alternating current being in general less than unity is in no way due to any special or abstruse properties of alternating currents. It is merely due to the fact that the currents are varying and that the ratio of the voltage to the current is not at every instant the same. Actual wave forms are anything but simple and are not the same for the current and for the voltage. Without any supposition as to the wave forms the author gives a brief but general proof that unless the ratio of volts to amperes is constant at every instant the power factor must be less than unity. The author then discusses the possibility of using "compensators." If a compensator is used at the generating station, only the generator is affected by it. If the losses in a long feeder are to be reduced the compensator must be put at the end of the feeder nearest the load. If there are a number of feeders operating in parallel at the central station and each supplying a separate load, a compensator can be used at the station to raise the power factor of the generator to unity, but the currents and losses in the feeders will not be affected thereby. If a compensator be put at the load end of one of the feeders the current in this feeder may be reduced to a minimum, but the other feeders will take exactly the same current as before, and the power factor of the station, though probably improved, will not necessarily be high. To raise the power factor to unity, both for generator and mains, it would be necessary to compensate each feeder at the load end. If the feeders supply synchronous motor-generators, each feeder can have its power factor raised to unity by adjusting the excitation of the synchronous machine, such adjustment providing the compensation required, but unless the motor-generator loads affect one another it is not possible to alter the power factor of one feeder by adjusting that of another. Similarly when several station generators are paralleled to bus-bars, the power factor of the different generators may be equalized by separate adjustment of the excitation of each generator; but any further improvement of the power factor can only be obtained by means of compensators placed beyond the bus-bars. In the case of long high-tension mains the capacity current may be very large and compensators have been proposed in such cases to reduce the current at the station. But the compensator in such a case may easily do more harm than good. Whether it is placed near the generator or near the load, the heavy current along the line needed to supply the cable condenser cannot in any way be altered, so that the copper losses in the cables are unaffected. The current through the armature of the generator may, indeed, be reduced, but such current helps to magnetize the field magnets of the generator, which, therefore, needs a lower magnetizing current, involving smaller field-coil losses for the same voltage. The attachment of a compensator to the mains reduces the armature losses, but increases those of the field coils, while it also absorbs considerable power itself, and it may easily happen that the total losses are increased by its use. In any case it can only be useful at times of light load, for alternating-current loads are nearly always such as to take lagging currents, which are such as to require a compensating current exactly like that taken by a condenser to neutralize the idle currents, and to raise the power factor of the system. "The cable current, in most circumstances, is a positive advantage, and any attempt to compensate it is a move in the wrong direction." The only important case of compensators is presented by synchronous machines which have the ideal characteristic of combining load and compensator in the same apparatus and all that is necessary to adjust is the excitation of the field. Power-factor meters are theoretically very perfect, and, like the Siemens dynamometer, are unaffected by wave form or frequency effects. But, like all instruments, they

are subject to practical defects arising from the effects of friction when the deflecting forces are weak, or from the influence of stray magnetic fields or, of course, from defects of manufacture or calibration. The power factor of an alternating-current circuit is such an important feature of its work that a power-factor meter has become a necessary adjunct to the switchboard.—Lond. *Elec. Eng'ing*, May 2.

Wires, Wiring and Conduits.

Aluminum and Copper.—A comparison of copper and aluminum for electric conductors. The chief figures for such a comparison are given in the following table:

	Hard Copper.	Aluminum.
Specific weight	8.9	2.7
Thermal expansion coefficient	0.0000165	0.000023
Tensile strength in kg. per sq. mm	38 to 44	18 to 20
Elasticity limit in per cent of tensile strength	40 to 50	35 to 50
Elongation up to elasticity limit, in per cent	0.15	0.14 to 0.16
Elongation up to breaking load, in per cent	2 to 3.5	about 4.5
Conductivity in comparison with pure soft copper in per cent	96	54 to 56
Temperature coefficient of resistivity	0.0040	0.0038 to 0.0040

An aluminum line and a copper line of the same length have the same resistance if the ratio of the cross-section of the aluminum to that of copper is 90 to 54. It is economical to use aluminum instead of copper if the ratio of the price of copper to aluminum is larger than 0.54. The present prices of 100 kg in Germany are $68 for copper and $90 for aluminum which gives a ratio of 0.755, so that at present a considerable saving may be obtained by the use of aluminum. Fig. 4 gives the

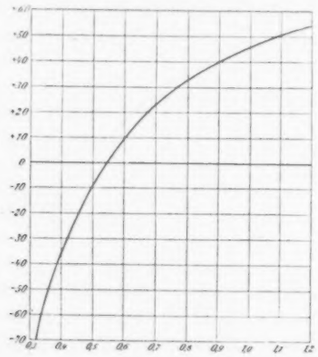


FIG. 4.—ALUMINUM AND COPPER WIRE COST CURVE.

savings which are possible in per cent for bare conductors for different ratios of the price of copper and aluminum. The abscissæ are the ratio of the price of copper to the price of the same weight of aluminum. The ordinates give the saving which is possible by the use of aluminum, in per cent of the price of copper. It will be seen that copper is cheaper as long as the ratio of the prices is below 0.54. At this point the curve cuts the zero axle of abscissæ. On account of the larger diameter of an aluminum line the cooling surface is also larger, so that the increase of temperature with current is smaller. A distinct disadvantage of the aluminum line is its small strength. For this reason transmission poles must be placed nearer together than is necessary with copper lines.—*Elek. Zeit.*, May 2.

Wooden Poles.—C. Wade.—The first part of a paper read before the (British) Institution of Electrical Engineers. The author discusses the use of wooden poles for the support of overhead mains and gives the results of a series of tests, the first set of which showed that a compound pole of a construction, looking somewhat like the letter A, is very much stronger than a single pole of equal area. He also describes the different methods of fastenings used for compound poles of the A type.—Lond. *Elec.*, May 3.

Preservation of Wood Poles.—Wood poles are very apt to deteriorate rapidly at the surface of the ground, so that they have to be replaced long before the remaining parts become unsound. To remedy this trouble M. E. Löwit has devised a simple and successful guard, which consists of two concrete blocks placed round the base of the pole from a depth of 1 ft. below the ground level, the space between the pole and the blocks being afterwards filled up with cement, the upper surface of which is shaped to deflect water from the pole. These guards can be applied to poles already in place.—Lond. *Elec Rev.*, April 19.

Flexibles.—The first part of a full reprint of the paper by A. Schwartz on flexibles, with notes on the testing of rubber. It is stated that in the discussion which followed, the consensus of opinion was distinctly in favor of the use of pure rubber insulated flexibles in preference to vulcanized and that in general the quality of India rubber is becoming more unreliable every year.—Lond. *Elec. Eng'ing*, April 25 and May 2.

Wiring.—Several new proposed standardization rules for lamp sockets and wiring in general, which shall be voted on at the coming meeting of the German Association of Electrical Engineers. These new rules are also discussed in articles by A. Hermanni and P. H. Perls.—*Elek. Zeit.*, May 2.

Fuses.—G. J. Meyer.—The conclusion of his long illustrated article giving theoretical and practical notes on fuses. In the first part of the article the author discusses the heating of the fuses up to the melting point and gives a definition of the inertia of a fuse. He then discusses the phenomena during the second period, namely, the formation of the arc. Several practical conclusions are drawn and propositions are made for changes in the present rules of the German Association of Electrical Engineers. The author recommends the following two rules: Fuses in lighting networks must be able to withstand a continuous overload up to 50 per cent of the normal load; if the load is increased still further the fuse shall blow in a finite time ("in endlicher Zeit"). Fuses in motor networks shall withstand an overload of from 70 to 80 per cent of the normal load. If the load is increased still further they shall blow within a finite time.—*Elek. Zeit.*, May 2.

Underground Cables.—F. Fernie.—An article discussing the correct estimation of the depreciation for underground cables.—Lond. *Elec. Rev.*, April 5.

Localization of Faults.—W. A. Toppin.—An illustrated article giving practical suggestions on the localization of earth leakages on a three-wire network. Incidentally the author refers to the practice, which is sometimes found in three-wire direct-current systems with the neutral earthed, of periodically "flashing the outers." He thinks it is not advisable to subject the mains to twice their working pressure above earth since this would tend to cause more faults on the negative feeders and distributers than would otherwise be the case.—Lond. *Elec. Eng.*, April 12.

Electrophysics and Magnetism.

Nickel Alloys.—B. V. Hill.—Two classes of alloys of the ferromagnetic metals are of particular importance. The first are the steels, and it has become more and more apparent recently that the properties which render steel so universally useful are very closely connected with its magnetic characteristics. A second important group of alloys are those used for electric resistances, which are mostly nickel alloys. The author made an experimental investigation as to the effect of certain elements in changing the temperature of transformation of nickel when in alloy with them, but could not detect a simple relation between the atomic weights and this effect. It is probable that the properties of any alloy will always have to be found by experiment, though some surmises may be made beforehand as to its character.—*Physical Review*, April.

Units, Measurements and Instruments.

Comparison of Units of Luminous Intensity.—E. P. Hyde.—A summary of our knowledge of the comparative values of the different units of luminous intensity in the United States, Germany, England and France. Some interesting results are given on tests of the same incandescent lamps in the different national bureaus of the different countries. The table giving these results reveals several interesting facts in regard to the present stage of development of the science of photometry. A comparison of the mean values of the stationary and rotating lamps before being carried abroad and after their return gives some idea of the constance and portability of seasoned incandescent lamps as secondary photometric standards. The lamps were

carried about for two months, were packed and unpacked five times, were burned in all about two or three hours, and yet the mean value of the candle-power of the six stationary lamps was found to have changed by less than 3 parts in 1000, while the mean value for the six rotating lamps apparently changed less than 1 part in 1000. The question of a uniform unit is to be distinguished from that of a uniform standard lamp in terms of which the unit is expressed. The adoption of the unit is the more important of the two. As soon as an entirely satisfactory standard is presented, its general adoption will probably follow, and this is much more likely to result if the adoption of a new standard does not entail the adoption of a new unit. The Hefner lamp was recommended by the Geneva Congress as a secondary standard, but owing partly to the fact that the Hefner was not found as satisfactory in other laboratories as it had been found at the Reichanstalt, and partly, no doubt, because of the different value of the unit, its general adoption did not follow. The Carcel continues to be used in France, and the Harcourt pentane lamp is coming into general favor in England. The author then sums up all the different determinations of the ratios of Hefner, Harcourt and Carcel lamps. This summary is given in the following table:

	10-cp Harcourt to Hefner	Carcel to Hefner	10-cp Harcourt to Carcel
Reichsanstalt (using an electric comparison lamp)	10.9	10.7	1.02
Laboratoire Central (using an electric comparison lamp	10.76	10.76	1.00
Laboratoire Central and Laboratoire d'Essais (direct comparison)	10.72	10.73	1.009
National Physical Laboratory	10.95	10.69	1.024
Ratios computed from Bureau of Standards incandescent lamps	11.19	10.73	1.043
Best previous values (Bunte)	11.4	10.87	1.05

It is seen from this table that the best agreement is obtained in the ratio of the Carcel lamp to the Hefner lamp, whereas discrepancies amounting to 4 or 5 per cent occur in the other ratios. The most important result to engineers of the United States is the discrepancy in the ratio of the Hefner candle to the British candle as given by the Harcourt (10-cp) lamp. The value given by Bunte as the best previous ratio is 0.88, and so is the same as that recommended by the American Institute of Electrical Engineers and adopted by the Bureau of Standards. This value, however, is 2 per cent different from that obtained through the Bureau of Standards incandescent lamps, and 5 or 6 per cent different from the value found at the various laboratories. If, therefore, the British candle be taken as one-tenth the intensity of the Harcourt (10-cp) pentane lamp at the National Physical Laboratory, according to the values assigned the Bureau of Standards incandescent lamp, it is 2 per cent different from the candle in this country obtained from the Hefner lamp by using the ratio 0.88. If the British candle be taken as one-tenth the intensity of any Harcourt (10-cp) lamp, it would seem to be different from the candle in this country by 5 or 6 per cent. Whatever the amount of the difference, it would seem that the candle in use in the photometry of electric lamps in the United States is sufficiently different from the British candle, as obtained through Harcourt (10-cp) pentane lamps, to justify defining the unit obtained through the Hefner by use of the ratio 0.88 as the *candle* instead of the *British Candle.—Bull. Bureau of Standards,* Vol. III, No. 1, April, 1907.

Telegraphy, Telephony and Signals.

Milan Exhibition.—A. CARLETTE.—Continuations of his illustrated description of telegraph and telephone exhibits at the International Exposition in Milan. The telegraphic apparatus of Rowland is described and some notes are given on its use in Italy. A description is also given of an apparatus of the German Telephone Works by means of which telegrams are automatically stamped with date, hour, minute, etc.—*Jour. Telegraphique,* March 25 and April 25.

Miscellaneous.

Depreciation.—R. HAMMOND.—A paper read before the (British) Institution of Electrical Engineers on depreciation in private and municipal electric stations. The author's final contention is that a local authority should treat depreciation exactly as a company treats it. It should set aside annually such sums as, properly invested, will enable it to wipe off the value of the machinery and plant at the end of its life. If the loan in respect to such machinery and plant is for a period similar to that of their life, then no further sum need be set aside annually. If, however, the loan, as in the case of some local authorities in the metropolis, be for a period of 42 years, whereas the equated life of the plant was agreed to be 25 years, then the annual instalments should be of such amount as would produce the capital sum in 25 years. The actual contributions to the 42-year sinking fund would be treated as part payment and it would be necessary to set aside a further sum annually to bring the contributions up to a 25 year's basis.—Lond. *Elec.,* April 26. Another abstract of the paper, together with a long account of the discussion which followed and which brought forward considerable criticism, may be found in Lond. *Elec. Eng'ing,* May 2.

BOOK REVIEW.

GOLD MINING MACHINERY. A PRACTICAL HANDBOOK FOR THE USE OF MINE MANAGERS AND ENGINEERS. By W. H. Tinney. New York: D. Van Nostrand Company. 308 pages, 96 illustrations. Price, $5.

This book is intended to give practical information to those who are about to engage in gold mining, concerning the selection, arrangement and operation of machinery for mining, hoisting, conveying, crushing and otherwise preparing the gold-bearing ores. Also to give directions and valuable suggestions to those already engaged in the work. The author has evidently had practical experience along these lines, giving many details of sizes, capacities and weights of various machines used that would be overlooked by a less practical writer.

The several chapters treat of motive power, engine erecting, boilers, chimneys, fuel, pumping machinery, winding machinery, air compressors, rock drills, crushing machinery, concentrating and gold extracting plant, transmission of power, piping, tackle, tools and details for estimates. When giving directions about boilers the practice of drawing fires in case of failure of the water supply, is condemned, which is eminently proper, as it is much better to cover the fires with wet ashes or fresh coal. The too common practice of calling the height to which water is forced by pumps, the lift, is followed in this book, but is evidently an incorrect statement, as a pump must be above or in advance of whatever it lifts.

While writing of new machines and appliances, the author says: "Perhaps managers would not be so conservative in testing new ideas if inventors were less prone to perfecting them at other people's expense." This idea can be applied to machinery for other purposes as well as to that used in the gold mining industry, with equal profit.

Explicit directions are given for splicing wire ropes or cables, so that they will run over pulleys and through blocks without trouble. These will enable a good mechanic to splice these ropes without previous experience, which is a valuable accomplishment where a plant is located in a wilderness. Attention is called to the fact that in all such enterprises endless confusion arises from the use of two different kinds of pipe and that care should be taken not to purchase American pipe where the English standard is in vogue, and vice versa.

The entire work is written in a comprehensive manner which makes the information available for everybody who can understand descriptions of machinery of any kind, and directions for operating the same.

A CORRECTION.—In the review notice of Dalemont's "La Construction de Machines Electriques," which appeared in the issue of April 27, the price of the book was erroneously stated to be 2.50 francs instead of 12.50 francs.

Combined Generating Station and Electric Automobile Garage in Philadelphia.

By Harry Y. Haden.

A plant of considerable interest is at present being built in Philadelphia, for the Auto Transit Company of Philadelphia which will shortly place a number of electric omnibuses in service in that city. A description of this plant, the first of its kind, will doubtless prove of interest to engineers in general.

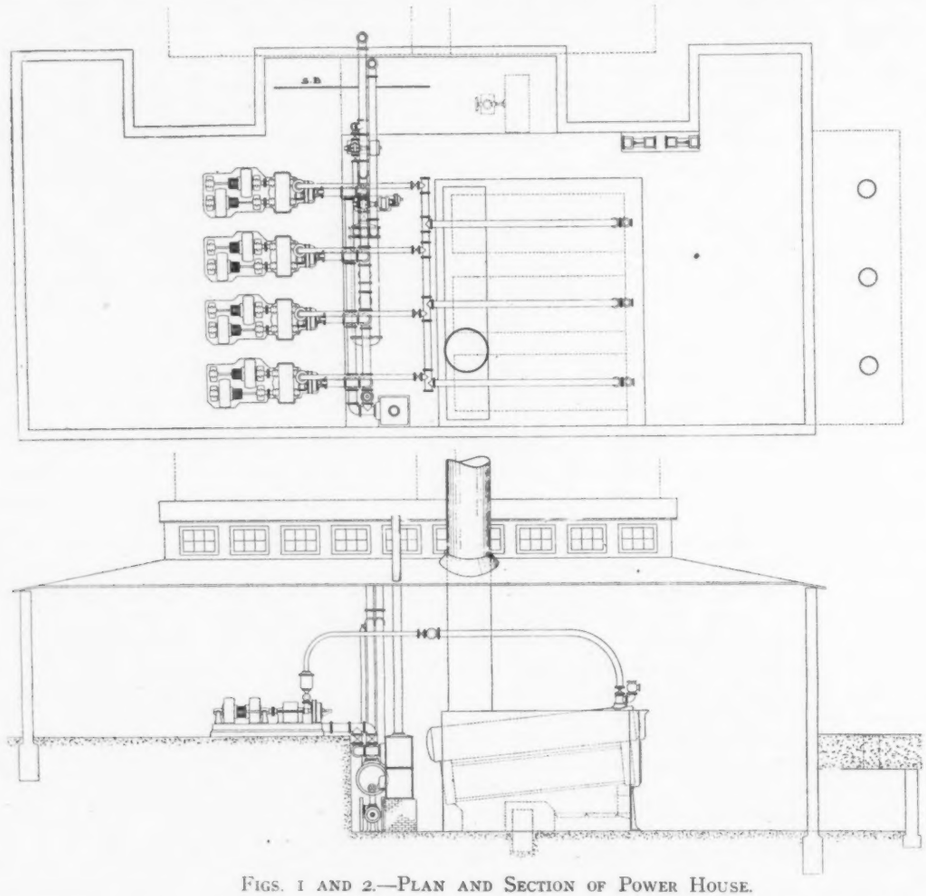
The buildings and power plant are now well under way, and it is expected to have the entire installation completed by the beginning of August. There are two buildings, the larger of which measures 128 ft. x 169 ft., and is used in the main part as a garage for fifty 36-passenger electric omnibuses and also as a repair shop. One end of this building will have two stories, the second of which will contain the main offices, etc. The walls of this building will be constructed of brick, the floors being of concrete. The smaller building will be 82 ft. x 169 ft., and will contain the storage battery plant and power house and also the battery repair section. A second story over this section will be used as a general store room. The construction of the battery room will allow of the maximum ventilation and there will be practically no exposed iron work, on account of the fumes from the batteries. Wherever iron must be used, it will be thickly coated with acid-resisting paint. The battery floor is of asphalt, and vitrified brick is used to line the two trenches, in which a small electric truck runs. This truck carries the charged batteries to the buses and receives the exhausted batteries in return. Two two-ton electric driven cranes operating from a central cage will handle these batteries from the electric truck to the battery tables. There will be in all 120 battery trays placed on wooden trestles insulated on glass feet and controlled from a distributing board, located in a special switch gallery. All the necessary cables will be covered with lead and will run under the trestles supported above the floor.

The storage batteries to be used in this plant are manufactured by The Electric Storage Battery Company, of Philadelphia. Each set of batteries for an omnibus will consist of 42 21-MV exide cells. These cells will be carried in a single tray, the cells being connected permanently in series, and changes in speed being made entirely by varying the combination of motors on the vehicles.

The so-called three bus-bar method of charging will be used, in which a battery, as soon as it is taken off a vehicle after a trip is connected directly on to the bus of lowest e. m. f., which is run at about 2.3 volts per cell, and the battery will be allowed to take whatever current demanded. As soon as the current decreases to a specified value the battery connections are transferred by means of a switch to the bus-bar next higher in e. m. f., and allowed to charge from this until the current again falls to the specified value when it is transferred to the bus-bar of highest e. m. f. on which the charge is completed.

The main generators in the engine room are so arranged by means of three-pole switches that any generator can be connected to any of the three bus-bars. A motor-driven booster set is also provided, so that at any time when the total load on the three bus-bars is within the capacity of one generating unit, one of the generators of this unit may be run on one bus, the other on the second, and the booster set used either to boost or to lower the voltage from one of these buses to the third bus. The combination, of course, is varied from time to time depending on the load of the various buses at the time. It might be said in explanation at this time that the generating sets to be employed are of the De Laval steam turbine twin generator type; hence it can be seen that one turbine set can give two voltages at one time, both generators operating entirely independently of each other, excepting in the matter of speed.

The positive bus of the entire system is common; three



Figs. 1 and 2.—Plan and Section of Power House.

separate negative bus-bars being run for the three voltages. The common positive bus also runs throughout the battery room, and the positive terminal from each charging table is connected direct to this positive bus-bar. From the negative side of each charging table a separate cable runs to the charging switchboard panels on the gallery, where there is provided a three-pole switch, by which this cable can be connected to any one of the three bus-bars. There will be a total of 10 charging panels, each taking care of 12 charging tables; there being 12 three-pole switches on each of the charging panels.

This ammeter for each battery charging circuit is connected by a two-conductor flexible cord with a two-prong plug, which can be placed in the clips of the three-pole knife switches in place of the switch blades used for closing the circuit.

An interlocking arrangement is provided so that the ammeter plug cannot be inserted in the clips of the switches when the switch blade connecting the battery circuit to any one of the buses is closed, thereby preventing the possibility of short-

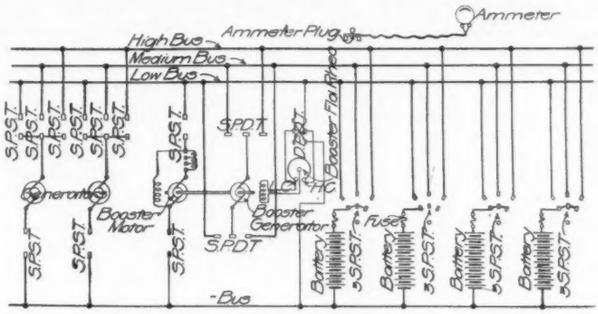


FIG. 3.—DIAGRAM SHOWING THE METHOD OF CHARGING THE BATTERIES.

circuiting two bus-bars through the ammeter and the switch blades.

Figs. 1 and 2 show a general layout of the power plant. Water-tube boilers operating under a pressure of 160 lbs. per sq. in. will develop steam for three, and eventually four 150-hp De Laval steam turbines. Each generating set, as before stated, will consist of two 50-kw dynamos, each of which will be separately wired to the switchboard. The turbines will exhaust into one large surface condenser, and the piping arrangement is such as to allow either of these units to exhaust at any time through the heater, from where the steam will be conducted through the heating system in the buildings.

A diagram showing the wiring arrangement is given in Fig. 3.

Cooling water for the condenser will be circulated over two open cooling towers, one of the circulating pumps being driven by steam turbine, and the other by an electric motor. The coal will be stored in bunkers below the pavement, and a forced draft system will be used, as it is intended in this plant to burn a low grade of anthracite coal.

The switchboard wiring will be carried in one main trench provided with cast iron covers so that any wire can be gotten at with ease. The distributing board, which is placed in the gallery of the battery room, is entirely separate from the engine room switchboard. The former will be operated by the battery superintendent, and the latter by the operating engineer. Two men will be employed on each shift in the engine room, namely the chief engineer and his stoker. There will be three shifts and the heaviest portion of the charging will occur from midnight until six o'clock in the morning, during which time all the buses will be in the garage. The total distance covered in one trip is a little less than 10 miles, and it has been found that one battery charge will be sufficient for three trips, or about 30 miles. The method of handling the buses as they come in and out from their trips, is as follows:

The bus is run into a passage way and brought in close connection with an electric truck, which runs in a trench way; then by one operation of a small electric ram, the exhausted batteries are pushed off the truck onto a small trolley, and with the same movements, the recharged ones are pushed in position. The omnibus then continues on its next trip. At the end of the final trip the same operation is again gone through, with the exception that a blank piece is placed between the ram and the old batteries, in place of the new cells, and as soon as the exhausted batteries are removed, a connection is made with a small trolley running overhead, which is connected from the main generators, and the omnibus is run with power from this source across the street into the garage, onto a transfer table. Here it is disconnected from the trolley wire and the transfer table is propelled electrically to a position opposite the space in which the bus is to be located. Connection is then again made with an overhead wire, and the omnibus run into its space. In this whole operation the omnibus never changes its direction, and therefore the time taken from the arrival of the bus in the building until its housing is very short.

In the morning the operation is reversed, and the first omnibus will start on its trip about 6:30, returning on the last trip at about 11:30 p. m.

The interesting mechanical feature of the omnibus itself is the independent motor drive, each wheel having its own motor, in this way obtaining a minimum of friction and maximum of traction. The body design has been copied directly from the double-decked omnibuses operating in London, England, and the chasses are identical with those of a recent contract for 100 for a large London omnibus company, placed with the Commercial Truck Company of America, who is also the builder of the omnibuses for the Auto Transit Company of Philadelphia.

The buildings and power plant are being constructed by Messrs. Dravo, Doyle & Company, of Philadelphia and Pittsburg.

The "Linolite" System of Show Window Lighting.

The "Linolite" system, which is already extensively used in Europe, is now making its first appearance in this country. The fitting is essentially what it is called—a "line o' light"—formed by placing end to end and close together in a continuous reflector a series of long tubular glow lamps with single filaments running from end to end of each lamp. Though the "Linolite" system has thus far been particularly applied to the lighting of show windows, it is equally adaptable wherever a continuous concealed source of light is required, occupying very little space.

FIG. 1.—ARRANGEMENT OF LAMPS IN REFLECTOR.

The system has been particularly devised to meet the following technical and scientific desiderata for window lighting:

(1.) The source of light should be screened from the exterior and all the available light from the lamps utilized inside the window in the direction required.

(2.) The intensity of illumination inside the window should be sufficiently above the general illumination surrounding the window to attract attention.

(3.) The light should be evenly distributed.

(4.) The fitting should be as small and unnoticeable as possible in order that the contour of the window may be unimpaired.

(5.) The source of light should be located as close as possi-

ble to the glass so that goods displayed also close to the window may be properly illuminated.

(6.) Assuming incandescent electric lamps as the illuminant, their several parts and the lamps themselves should be arranged in such a manner as to give the most available light over the area required for a given consumption of electrical energy.

Fig. 1 shows the general arrangement of the lamps in a reflector of semi-circular section. The filament, which may be of either the high efficiency or the carbon type, instead of being

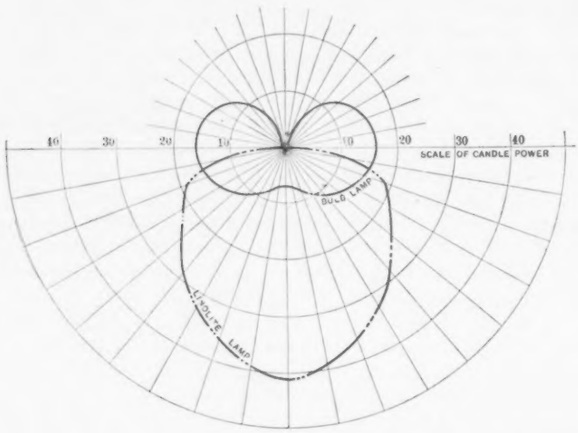


FIG. 2.—POLAR CURVES OF CANDLE-POWER OF 16-CP BULB AND 16-CP LINOLITE LAMPS.

coiled or "bunched" as in the "bulb" lamp are stretched out straight in a glass tube, the caps at each end having one central contact. With the exception of a small loop in the center to take care of expansion, all parts of the filament are thus in the same relative position as regards the reflector. The position of the filament has been chosen to give the greatest possible efficiency and is near the focus of the reflector section.

The reflector is drawn in one piece from sheet metal, usually aluminum, polished on the inside, with a tubular bead on each edge (Fig. 3) to carry the wiring. It is only 2¼ ins. wide, enabling the fitting to be wholly or partly concealed behind the framework of the window. The total depth of the fitting from the front of the lamp to the back of the reflector is one inch. With "Linolite" run up the sides and over the top of the window frame a concealed source of light is furnished wholly located in a plane less than one inch distant from the window.

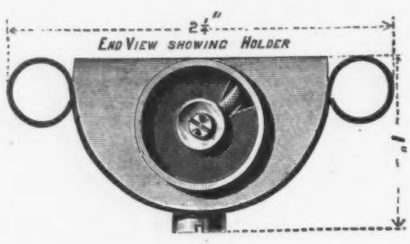


FIG. 3.—CROSS SECTION OF REFLECTOR.

The lamp holders are an interesting feature. Each holder is common to two lamps, but has only one terminal in the form of an insulated spring plunger, which enables the lamps to be instantly fixed or removed.

As regards efficiency, the stretching out of the filament and the location thereof throughout its length uniformly within a continuous reflector of suitable section undoubtedly utilize the light rays to greater advantage than the bunched or coiled filament.

Fig. 2 is a polar curve of mean horizontal candle-power showing a comparison between a bulb lamp with horizontal axis as is often found in show windows and Linolite in its usual position, both taking the same current. The increase in candle-power is notable over the angle covered by the dotted curve. Taking the mean horizontal candle-power of the "Linolite" lamp is 16 candle-power, the reflector increases the effective candle-power 100 per cent over an angle of 70 degrees, and 50 per cent over an angle of 100 degrees.

It is unnecessary to describe the many uses besides window lighting to which this system may be as usefully applied. Used in the direct or indirect sense, for direct or reflected lighting, turned this way or that, and made in units of various power, it adapts itself to the lighting of office desks, railroad and street cars, theater stages, pictures, signs and private apartments, for which latter purpose it is used in ornamental form on the reflected light system.

The patent rights in various European countries are already being worked, the British Linolite Company having placed over 10 miles of the system. The Linolite Company of America is now in course of formation, to which concern the inventor, Mr. A. W. Beuttell, is giving his attention.

High-Tension Insulators.

Three patents were issued May 14 to Mr. Louis Steinberger relating to high-tension pole-line insulators. Mr. Steinberger is well known as the manufacturer of electrose, used so largely for telephone mouthpieces and receiver cases, and in recent years has given much attention to molded high-tension insulators, one type of which is used on the Buffalo line of the Canadian Niagara Power Company. The most interesting of the patents describes a horizontal type of insulator shown in Fig. 1, designed to meet the severest conditions encountered in high-tension transmission work. The particular advantages claimed for this type is that it possesses the greatest possible strength; that it utilizes the full strength of the cross arms and conductor and permits a greatly increased length of span, involving a saving of 50 per cent in cost of poles or towers and in line maintenance, that it affords protection for the cross arms and is practically weather and storm proof. It is especially adapted for single and double catenary line construction and for dead-ending cables. Means are provided for preventing chafing or

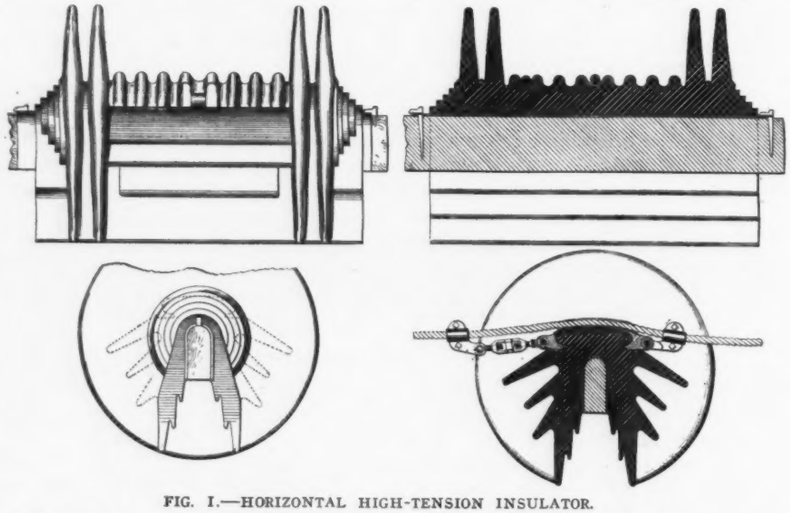


FIG. 1.—HORIZONTAL HIGH-TENSION INSULATOR.

wearing of that part of the insulator upon which the wire or or cable rests, and for flexibility in the clamping mechanism used for controlling the cable tension. Means are also provided for supporting the cable in a manner to make each span an independent unit.

The patent specification enumerates the following objects of this type of insulator design:

1. To provide an increased expanse of insulating material upon a cross arm or analogous member disposed horizontally,

for the purpose of preventing leakage from the conductor to the arm. 2. To increase the extent of surface of the insulator so as to reduce the amount of surface leakage. 3. To prevent the formation of arcs, by lengthening the path through which the arc might otherwise tend to occur. 4. To provide improved facilities for mounting the insulator and for taking it down. 5. To insure the retention of dielectric properties in the insulator, should a part of the construction be broken. 6. To prevent undue chafing or wearing of that part of the insulator upon which the cable or other conducting member rests. 7. To clamp the cable or analogous conducting member in a predetermined position relatively to the insulator. 8. To provide the insulator with means for tightening and slackening the cable. 9. To secure the wearing plate firmly in position upon the insulator by appropriate anchorages. 10. To provide for regulating the degree of clamping pressure upon the cable or analogous member incidental to holding the cable firmly in relation to the insulator. 11. To prevent undue rigidity in the clamping mechanism used for controlling the tension of the cable. 12. To reduce the number of poles usually required for a given distance. 13. To provide a line insulator of novel construction, which is mounted directly upon and is supported by the cross-arm, thus obviating the necessity of employing a pin or other auxiliary device for supporting the insulator, and also providing the greatest possible strength in the support and permitting the employment of a greatly increased length of span between poles with perfect safety. 14. To provide a practically storm-proof line insulator having means for securely supporting the cable in a manner so as to make each span an independent mechanical unit.

Fig. 2 shows a form of insulator designed to achieve the following objects: 1. To provide an insulator pin containing a strengthening member of insulating material completely embedded therein. 2. To increase the mechanical and dielectric strength of this strengthening member. 3. To make certain provision for rendering the insulating pin water-tight at its base. 4. To render a certain region encircling the base of the pin as dry as possible. 5. To provide an improved water-shedding course for conveying moisture away from the pin and cross-arm. 6. To increase the insulating qualities of the pin and its accompanying parts. 7. To provide upon the pin or analogous member a drip edge raised above the cross arm for the purpose of maintaining the latter comparatively dry at the point adjacent to the hole in the cross arm. 8. To provide certain facilities for holding the pin upon the cross arm and to carry off the water running down the body of the pin to either side and away from the cross arm. 9. To supply certain mechanical details of construction for improving the mechani-

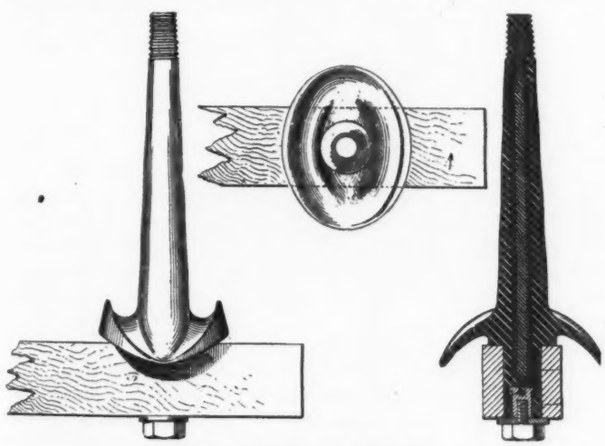


FIG. 2.—INSULATOR AND PIN.

cal strength of the insulating parts and of improving the general efficiency thereof. 10. To provide a novel means for strengthening a member having a longitudinal conformation. 11. To provide a composite strengthening member made up from a plurality of tubular portions. 12. To provide a composite strengthening member made up from a plurality of tubular portions and a solid core portion. 13. To make certain provision for protecting the insulating pin at its base and for protecting certain portions of the cross arm adjacent to this base from water, snow, etc.

The objects of the design shown in Fig. 3 are stated as follows: 1. To give the insulator a composite structure so that it may be assembled without the necessity for handling pieces of excessive weight. 2. To confer a great amount of mechanical strength by the use of a comparatively small quantity of material. 3. To enable each different part of the insulator to serve as a complete insulator whenever necessary or desirable.

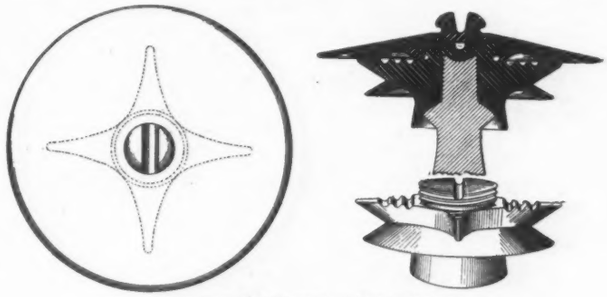
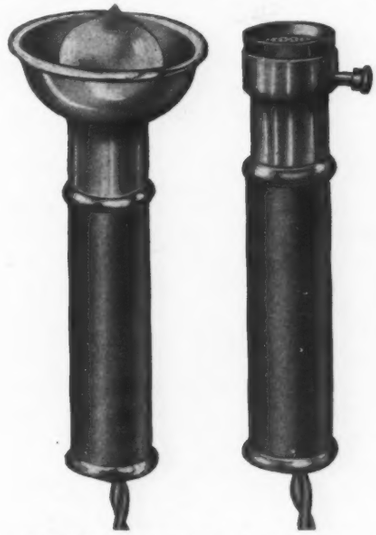


FIG. 3.—COMPOSITE INSULATOR.

4. To fit the supporting pin with the lower hood in such manner that the latter rests upon a comparatively broad bearing surface. 5. To provide an insulator having hoods of comparatively large surface, so as to adapt it for supporting conductors carrying currents of very high potential. 6. To provide a number of rests for supporting the conductor or conductors. 7. To make the several parts of the insulator separable so that either of the parts may be readily replaced when injured or destroyed; and to achieve certain other electrical and mechanical objects increasing the general efficiency of the insulator. 8. To provide an insulator with means for supporting, simultaneously, a plurality of conductors.

Match-Less Light Novelties.

The illustration at the left represents an electric inspection lamp, for use on automobiles, launches, etc. It may be connected by cord to the spark batteries, and owing to its con-



EXPLORING LAMP AND CIGAR LIGHTER.

venient shape every part of the machinery may be easily examined. The lamp is of eight candle-power and behind it is a reflector which gives a powerful concentration of light rays.

The device shown at the right is an electric cigar lighter, also designed for use on automobiles, electric launches, etc. By

pressing the button the circuit is closed through a spiral of high-resistance wire which becomes incandescent. The wire is embedded in a lava button, which also becomes incandescent through its contact with the hot wire, the area thus heated being sufficient to light a cigar with ease. This style of cigar lighter is adaptable to any exposed situation where electricity is available, the weather conditions having no effect upon its use. These devices are made by the Match-less Light Company, Caxton Building, Cleveland, Ohio.

Long-Scale Switchboard Instruments.

The American Instrument Company, Newark, N. J., has placed upon the market a line of long-scale electrical measuring instruments to meet the demand for switchboard instruments suitable for use where readings must be made from a considerable distance. The scales are approximately 14 inches long. The mechanical construction of each instrument is such that when it is properly mounted it projects less than 2 inches from the front of the board and yet it requires that the hole in the board for its reception be only 6⅝ in. in diameter, and circular in form. Thus the instrument is easy to mount, the

FIG. 1.—LONG-SCALE VOLTMETER.

panel is not unduly weakened, and it possesses all of the advantages of the flush-type of instrument.

The instrument proper is mounted in a circular box, as shown in Fig. 2, which projects through the board, while the shallow portion of the case containing the scale lies flat against the front of the switchboard.

The ammeters are arranged to operate in connection with interchangeable shunts which are adjusted to give a uniform drop of exactly 50 milli-volts on full load. Each instrument together with its leads is adjusted to have a resistance of exactly one ohm and to give exactly the full scale deflection on 50 milli-volts. Thus any shunt of any capacity can be used with any instrument. The voltmeters are adjusted to have a uniform resistance of exactly 100 ohms per volt, so that "multiplying resistances" can be used interchangeably when required.

These instruments are made by the American Instrument Company, of which James G. Biddle, 1114 Chestnut Street, Philadelphia, is general sales agent.

Sectional High Voltage Insulator.

The high price of copper calls for higher line voltages, and now that proper insulators may be obtained the next large transmission lines may probably be equipped for line pressures of from 80,000 to 100,000 volts. The insulator shown herewith is a pendant form, the conductor being carried beneath the insulator.

With the style of construction adopted the insulator may be built up of any number of sections without weakening it mechanically. To obtain greater insulation all that is necessary is to add sections. This is an advantage, as the insulator may be installed for a moderate voltage, and if it is desired to raise the line pressure at a later date, all that is necessary is to add more sections to the insulator.

The insulator is free from still air spaces which might clog with dirt, and at least one-third of the surface is cleaned by the rain. As all the sections are small, the insulator is low priced, compared with the voltage at which it can be operated.

The principal advantages of this type are great mechanical and electrical strength, long leakage path, and the ease by which the capacity may be increased. This form is made by the Lima Insulator Company, of Lima, N. Y.

Electric Cooking.

Some valuable information concerning the consumption of electricity required in electric cooking has been collected by the Manhattan Electric Range Company, New York, N. Y. It has

FIG. 2.—SIDE VIEW OF VOLTMETER.

SECTIONAL INSULATOR.

been found that by using a Bayno electric range and broiler consuming 25 amperes at 115 volts, the following substances could be cooked in the time indicated:

Broiled 1-pound Lobster	12	minutes
" Planked Shad	15	"
" Salmon	8	"
" Sirloin	5	"
" Porterhouse	10	"
" English Mutton Chop	8	"
" Mutton Chops	5	"
" Lamb Chops	4	"
" Spring Chicken	7	"
" Squab	5	"
" Quail	4	"
Baked Potatoes	30	"

The range and broiler is designed for a current consumption somewhat larger than is usual, but the heating is so effective that the time required has been much reduced and the energy consumption and cost of operation have been lessened with an increase in the rapidity of service and output from a single equipment. With the electric cooker there is no odor of fuel, and the red heat so necessary for the proper broiling that retains all the juices is secured in a few seconds after the current is turned on. A series of coils of wire over the oven serves to heat the top of the range, and at the same time another series under the oven does the baking. Broiling may be done from top or in a special broiler in which the gridiron is placed in a special receptacle, both sides of which are lined with resistance coils, which get red-hot and cook each side of the steak at once, searing the surface instantly, so that all the juices are retained. It is claimed that cooking by electricity requires only one-third of the time taken by any other method.

Metal Cable Terminals.

The all-metal cable terminal illustrated herewith are constructed entirely of pressed steel, and no castings are used in their construction. It is claimed that all chances of breakage are entirely eliminated. All of the metal parts are heavily galvanized to prevent rust; the covers are made of sheet steel which is also heavily galvanized, and the terminals are therefore exceedingly durable. In the terminal shown in Fig. 1, the cable is brought in through a self-soldering nozzle, and the conductors are fanned out and soldered to the clips inside the

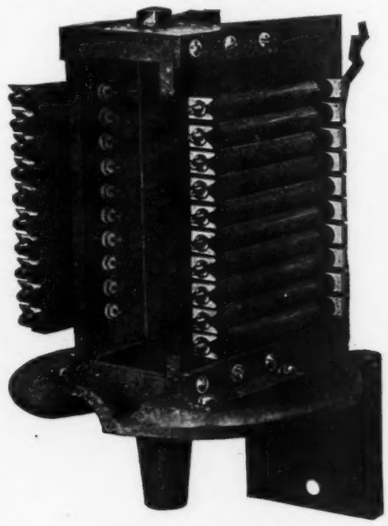


FIG. 1.—CABLE TERMINAL WITH COVER AND FRONT PLATE REMOVED.

moisture-proof cable box, the front plate or cover being removed for this purpose. After the cable wires have been distributed and soldered, the front plate may then be fastened on securely, a rubber gasket rendering the joint moisture proof. As an additional protection to the cable, the plug in the top of the box may be unscrewed and the box filled with paraffine or compound.

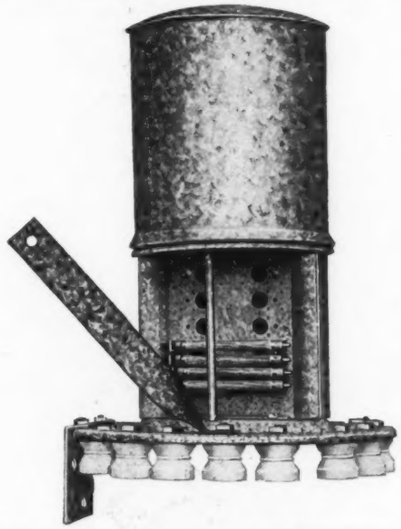


FIG. 2.—COMBINATION TERMINAL AND DISTRIBUTING RING.

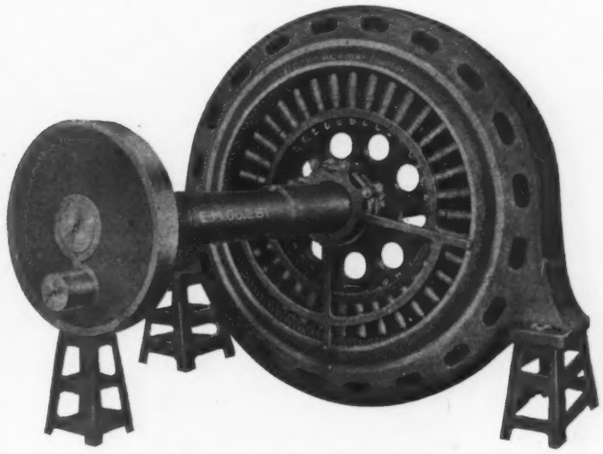
No pot-head is necessary with this terminal, as the box itself forms a moisture-proof ending for the cable.

The type shown in Fig. 2 is made for use with a pot-head. It is arranged for individual protector mounts, which can be put on as needed. Any initial capacity can thus be secured and the capacity of the terminal can be increased as desired by simply adding protector mounts. As in all types of these terminals, it is equipped with special springs that hold the cover in place when it is raised, and which also lock them in place when they are down. This makes it unnecessary to hang the cover up on the pole or to have a chain from which the cover dangles while it is off.

The all-metal terminals are manufactured by Frank B. Cook, 246 Lake Street, Chicago, Ill.

Engine-Type Alternators.

The illustration herewith is aranged for showing some of the interesting details embodied in the construction of a line of engine-type alternators recently placed upon the market by the Electric Machinery Company, Minneapolis, Minn. It will be noted that the brush-holder equipment is entirely self-contained. The pole pieces are attached to the revolving element in an unusual manner. The laminations project through an annular ring on the hub, being held in place by means of a taper wedge driven through a slot provided for that purpose.

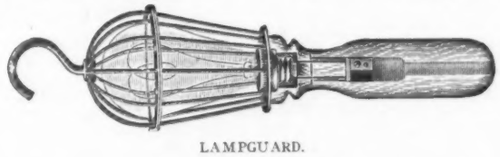


ENGINE TYPE ALTERNATOR.

After the taper wedge is in place, a small radial pin is driven in behind it, thus locking it in position. In this way the finished revolving element is made without a bolt or nut or any other part to work loose during operation or at any other time. The entire stator core is also put up without any retaining bolts or nuts or screws. The only bolts and nuts about the whole machine are those used to fasten on the bonnets on each side and to fasten the brush rigging.

Compact Lampguards.

The Standard Electric & Chemical Company, 224 South Clinton Street, Chicago, has recently been making some improvements in portable lampguards which have resulted not only in great increase in strength, but in lighter weight, smaller size and greater accessibility. The guard and handle illustrated herewith is only 14 ins. long for a 32-cp lamp and 12 ins. long for a 16-cp lamp. The weights of these two guards are only 12 and 14 oz. respectively. The cage consists of 9 bars, re-



LAMPGUARD.

sulting in such great strength that the guard can be walked on without injury. To renew a lamp it is only necessary to loosen three screws in order to get the guard apart. These screws hold the two parts of the guard together with a kind of bayonet catch arrangement. A special design of socket is used in the handle and this socket can be made either keyed or keyless as the purchaser desires. This guard is also made in smaller sizes for taking a small battery lamp for use around an automobile.

Kuzel One-Watt Colloid Lamp.

The "Sirius Colloid" lamp, as Dr. Kuzel prefers to call it, is now commercially manufactured at Vienna, at Furstenwald-bei-Berlin and at Niukoping, Sweden, and it is stated that active preparations are making for its production in other countries. It has been actively taken up in Europe by Pintsch Brothers, whose names are so widely known in gas lighting, and who are making the lamp in Germany, in rapidly increasing quantities. At present lamps of 25 candle-power, 25 watts per lamp, are made almost exclusively, although 50 and 100 candle-power lamps have also been supplied to meet a limited demand.

The Kuzel filament differs from the tungsten and other specific metal or alloy filaments in that its material is obtained by

ONE-WATT COLLOID LAMP.

a process of reducing the metals employed to the colloidal state, thereby producing filaments of the requisite dimensions and electrical accuracy, and also of the required chemical purity and at the same time within a reasonable commercial cost.

Lamps have been made for burning in any position, but up to the present are available commercially in only the simple form adapted to pendant burning alone. The processes of mounting and exhausting are easily performed, but are not the same as those used in the manufacture of carbon lamps. The lamp is shown in the accompanying illustration.

Linemen's Solder Paste.

The Chase-Shawmut Company, of Newburyport, Mass., has placed on the market a new red solder paste. Electricians, linemen and others have often need for a convenient solder flux in such form as to be clean to handle and at the same time efficient. The red "E" solder paste, although new to the general public, has been used and tested for a number of years by individuals and found in every way satisfactory.

It is put up in collapsible tubes so that there is no waste, and it can be carried in the pocket or tool bag with perfect cleanliness. The paste is non-corrosive and does not act like an acid, but cleans the surface, and its action as a flux makes the solder run freely. Temperature, weather or material makes very little difference. It will keep indefinitely and is put up in two sizes of tubes, one ½ in. x 4 ins. and the other 1 in. x 6 ins. long.

Battery Motors and Generators.

The accompanying illustrations show a line of well designed and symmetrically proportioned miniature generators and motors for use with dry batteries as instructive toys. Fig. 1 is an

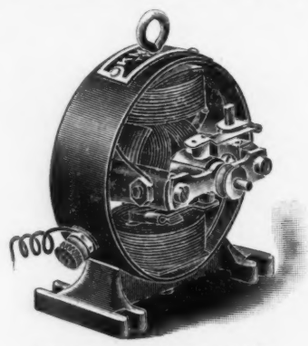


FIG. 1.—OPEN TYPE MOTOR.

open-type motor well arranged for amusement and instruction. Fig. 2 shows a semi-enclosed motor equipped with a reversing switch for starting, stopping or running the machine in either direction. Either of these motors may be operated from a

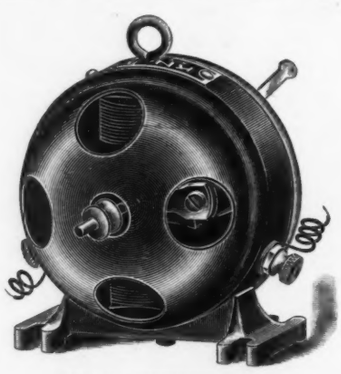


FIG. 2.—ENCLOSED MOTOR.

single 2½ x 6 in. dry cell. Fig. 3 illustrates a semi-enclosed generator rated at 4 amperes and 6 volts at a speed of 3000 r. p. m. It can be driven by a miniature steam or gas engine, or other source of power, and is suitable for electroplating,

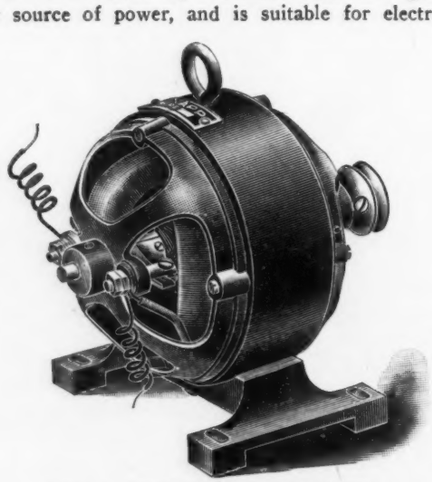


FIG. 3.—SEMI-ENCLOSED GENERATOR.

lighting lamps or operating motors, trolley cars or other appliances. These machines are built by the Knapp Electric & Novelty Company, 511 West Fifty-First Street, New York.

Industrial and Commercial News

Financial Intelligence.

THE WEEK IN TRADE.—Further progress was made in the distribution of Spring merchandise last week, but the season is still very backward and much stock will be carried over. Crop and trade reports are irregular, but there is a slight improvement visible as a whole, owing to higher temperatures. Agricultural conditions generally are backward, and here also the best of weather conditions are now needed for average development on planted acreage. Collections, like retail trade, are backward as a whole. Money is easy, with country banks free buyers of commercial paper, but sentiment as to the future favors hardening of quotations. Railway earnings reports are slightly better, gross gains for May being 17 per cent ahead of 1906, with net returns for March showing a slight decrease. The car situation has improved and congestion complaints have about disappeared. Export trade from New York has been greatly reduced by the dock laborers' strike, which still hampers shipments. Labor is well employed, strikes as a whole being few in number, and the scarcity of help is a source of complaint in widely separated sections of the country. General business among makers of finished iron and steel products reflects ebbing business in a few lines and record high activity in others. On the whole, the decreases in a few lines are balanced by gains in other channels. The tone of the markets for all grades of iron is strong. Furnaces are in as independent a position as was ever maintained. In the steel trades better deliveries from mills were reported. In many lines the gains against backwardness afford evidence that in a number of steel products little new business of importance has been booked within three months. Shapes, plates and structural material were in good demand. Rails were quiet for standard and light forms. Copper was slightly lower, offerings being larger, but business was light. No sales of electrolytic were made below 25 cents nor of lake under 25¾ cents in bona fide business closed last week. Aluminium is quoted at 45 @ 47 cents per lb. *Bradstreet's* reports 165 business failures during the week ending May 23, against 184 in the week previous and 170 in the corresponding week last year.

LOWER PRICE OF PLATINUM.—A good deal has been said lately about the price of platinum, which rose to $43 per ounce and has now declined to $34. A further decline is expected in some quarters, and the *American Jeweler,* discussing the subject, says: "The important feature of the month for manufacturing jewelers has been the drop in the price of platinum. As is now generally understood the skyrocket course of the prices on this indispensable metal has been due to manipulation. Some time ago we published a statement that the Russian mines, with the exception of a few small mines, had sold their output to a syndicate. The syndicate referred to is the Paris Refining Company, which has agreements with the principal refiners in London and Berlin, Germany, to sell them practically all of their product which goes to those countries and they were to act as distributing agents to the various refiners, who in turn distributed it to the consumers of the metal. Some American refiners had their suspicions aroused from the fact that while platinum was steadily going up the price of scrap was not advancing, which would be the case in any genuine scarcity of the metal. They therefore quietly collected all the scrap possible and sold it last January to the American agents of the combination at a price far above that for which they can now buy new metal. The prices, which in some cases went to $43 an ounce in small quantity, were regarded by the trade as prohibitory, and so many of them changed to other metals that the syndicate could not carry the load, for the simple reason that the loans they were obliged to make in order to buy and hold the metal, very soon ate up in interest all the profits which could be obtained from the increased prices from the public at large, and as these loans are now due and are being called, a forced sale of the metal was the result, with the consequence of a fall to $34 per ounce. Refiners generally are advising consumers to buy only for present needs, as there is every indication that a further fall will be forced by the use of mixtures of platinum and silver, silver overlaid with platinum, like rolled plate gold, and alloys composed mainly of nickel and silver. The only people who are really obliged to have platinum in the usual quantities are the makers of electrical lamps, as platinum is the only metal found so far which has the same ratio of expansion and contraction as glass and is therefore the only metal that can be used in incandescent lamps without the heat of the current forcing the metal from the glass and destroying the vacuum. The makers of chemical apparatus have been in the habit of using platinum for many purposes besides those of furnace uses, and they have duly reduced their use of the metal by the substitution of glass, quartz and other materials."

NITRATES FROM THE AIR.—The Frank and Caro process for deriving nitrogen artificially from the air has been taken over by two well-known American engineers, Mr. Frank S. Washburn and Mr. Charles H. Baker, of 100 Broadway, this city, who, with their associates, are about to form the American Cyanamid Company for the development of this most important industry. The final product which the process obtains is composed of limestone, coal and nitrogen, and is popularly called "Lime nitrogen," 20 per cent of the weight of which is nitrogen. The chemical name of the compound is calcium cyanamid. This compound not only has its direct use as an agricultural fertilizer, but will be most extensively used, it is expected, in the chemical arts for the production of ammonia, nitric acid and other useful things. As a measure of the magnitude of the consumption of Chilian nitrate it might be mentioned that the United States alone imported last year 375,000 tons of it, having a value of $20,000,000. A column of the atmosphere resting on any two acres of the earth's surface, contains the same amount of nitrogen as did last year's importation from Chile. The Agricultural Department at Washington is taking a great interest in the new fertilizer and is having it investigated by the department experts. Factories for its manufacture are now in process of construction in several of the nations in Europe, and one of them which is under way in Germany will involve the construction of a 75,000-hp water power plant. The parent company is the Societa Generale Per La Cianamide of Rome, Italy, which is controlled by the Deutsche Bank of Berlin and the Siemens & Halske Company, which financed the costly experiments and researches conducted by Messrs. Frank and Caro during the long period of experimentation leading up to their invention. The same German interests will have a considerable financial share in the American company.

ELECTRICAL EXPORTS.—A summary issued by the Bureau of Statistics of the Department of Commerce and Labor shows that of the $132,000,000 worth of iron and steel manufactures exported in the nine months ending with March, 1907, nearly $7,000,000 worth consisted of locomotives; nearly $6,000,000, sewing machines; $4,500,000, typewriters; over $6,000,000, electrical machinery; nearly $7,000,000, metal working machinery; over $17,000,000, miscellaneous machinery not separately specified; nearly $11,000,000, builders' hardware, including locks, hinges, saws, tools, etc.; more than $6,000,000, steel rails, and about $5,000,000, structural iron and steel. Of the more than $6,000,000 worth of electrical machinery exported, Canada was the largest purchaser, the exports thereto during the period under consideration having amounted to $1,500,000, while those to Mexico, Japan and the United Kingdom, the next largest purchasers, were valued at near $1,000,000 each.

SIGNAL CORPS PLANT.—Capt. L. D. Wildman, U. S. Signal Corps, Fort Omaha, Neb., is making up plans and estimates for a complete machine shop for the Corps to repair its telegraphic apparatus and material of all kinds, balloon machinery, small machines, etc. He desires to enter into correspondence with manufacturers on the subject and to secure necessary data as to all appropriate classes of machinery, including motive power, shafting, hangers, belting, machine tools, bench tools, etc. Any catalogues sent will be appreciated.

IMMENSE ORDER FOR STEEL PLANT.—The largest order for alternating current generators ever placed by one interest with any manufacturer of electrical apparatus in this country, has recently been awarded by the United States Steel Corporation to the Allis-Chalmers Company, Milwaukee, which has received orders for 32 gas-engine-driven electric generators, aggregating 68,000 kilowatts, 16 of which are to be installed in the new plant at Gary, Ind., now in course of construction by the steel corporation. The other 16 units are for the Homestead plant of the Carnegie Steel Company, the South Chicago and Bay View, (Milwaukee) works of the Illinois Steel Company; and for the central furnaces of the American Steel & Wire Company, Cleveland, Ohio. These are standard type, 25-cycle, three-phase alternators, and will be direct connected to twin tandem gas engines, operated on blast furnace gas, which is the gas collected at the top of furnaces and formerly allowed to go to waste. The use of electrical power in modern steel mills is now extended to cover practically all the machinery of the plant, the systems of telepherage, conveyors and appliances for handling hot metal being now universally driven from individual motors. At the Gary plant of the Indiana Steel Company the rail mill will probably require the greatest amount of power. This mill is situated about a half mile from the power plant, and will consume approximately 10,000 kilowatts to operate the induction motors which drive the main rolls. These motors range in capacity from 2000 to 6000 horse-power, and three of them have overload capacity of 9000 horse-power for an hour. The breaking-down stands in the rail mill for reducing ingots to fair-sized blooms, will be driven by two 2550-hp motors. The blooms will then go to the blooming mill, which is operated by one of the 6000-hp motors, and from these they will pass to the mills driven by two 4500-hp motors, receiving their finishing passes in the mill driven by a third 2500-hp motor. All the tilting and feed tables for the various passes, all hot saws, hot and cold pull-ups, the transfer tables, straightening machines and cold saws and all auxiliary machinery of the mill will be driven by electric motors. In addition to the orders for gas-driven electrical units enumerated, orders have been placed with Allis-Chalmers Company for gas-driven blowing engines as follows: Indiana Steel Company, Gary plant, eight 4000 horse-power; Carnegie Steel Company, Homestead plant, four engines each rated at 4000 horse-power.

THE COPPER SITUATION.—An interesting review of the copper situation is given in the May 20 issue of the "Copper Gossip" of the National Conduit & Cable Company. It says: "Dullness in copper is the characteristic feature of the market, and this has been the case for several weeks. During the past 30 days business in copper in this country has been extremely quiet, and the apathy of buyers is indicated not only by the meagre transactions, but by the difficulty in getting consumers to even bid for futures on a large scale. There is an absence of enthusiasm and aggressiveness from the situation that is depressing and discouraging to active trading. Although the larger and controlling interests stand manfully by their guns and continue to quote 25¼ for electrolytic wire bars, nevertheless, the hesitation of buyers must impress producers with the fact that the program for maintaining the market on that basis is not receiving a very hearty endorsement when judged by practical tests. The recent irregular price movements also tends to confuse the situation, and for some time it has been hard to arouse the interest of consumers in the market to the extent of creating important new buying. Conservatism holds manufacturers back from being in any haste to forestall future requirements, and confidence will need to be considerably stimulated before consumers will stock up heavily at the present market level. For some months we have been advocates of the hand-to-mouth policy in buying copper, and we still adhere to the advisability of this course. Business is in a very comfortable condition at present, but should there arise a distinct curtailment in trade generally it seems reasonable to expect that copper would share in the reaction. The prosperity of last year was phenomenal, and there are some consumers who profess to see signs of slacking up in demand already. But manufacturers are not, therefore, inclined to adopt a pessimistic tone on that account, as if the bottom was going to drop out of things. A gradual return to normal conditions in industrial lines may prove somewhat of a welcome experience to those who have been overtaxed by the strenuous demands of an intensified period of rush conditions which has prevailed for more than a year."

TELEPHONY IN AUSTRALIA.—The "Commonwealth of Australia Gazette" announces that tenders will be received at the office of the Deputy Postmaster-General, Brisbane, until Sept. 2, 1907, for the supply and delivery at Brisbane of the undermentioned telephone material: Four sections of a common battery switchboard and 650 subscribers' telephones. Schedule forms, general conditions of contract, and specifications may be obtained at the offices of the Comptrollers of Stores, Brisbane, Melbourne, Sydney and Adelaide. Tenders must be indorsed "Tender for Telephone Switchboard and Telephones," and be addressed to the Deputy Postmaster-General, Brisbane. They may be deposited in the tender box at the General Post Office, Brisbane; if sent by post, they must be prepaid and registered. Each tender must be accompanied by a deposit, or receipt for deposit, made with the Deputy Postmaster-General at Sydney, Melbourne or Adelaide, of 5 per cent of the amount thereof up to $5,000, and 2½ per cent for any additional amount exceeding $5,000. The lowest or any tender will not necessarily be accepted. The accepted tender will be recorded by a notice in the "Commonwealth Gazette," and such notice will be considered as an intimation to unsuccessful tenderers that their tenders have been declined.

TROLLEY FOR MUKDEN.—U. S. Consul-General W. D. Straight, of Mukden, reports as follows: The Japanese military authorities, during the occupation of Mukden, constructed a push-car tramway along the main thoroughfares and from the city to the railway station. Upon their evacuation this property was turned over to the local Japanese Settlement Association, which has intrusted its operation to a Japanese concern called the Okuragumi, and it is between these two that the profits are at present divided. The line is now used almost entirely for hauling materials for the repair of the city streets, which is now in progress, and the passenger traffic is as yet of practically no importance. The Okuragumi, however, plan within the current year to rebuild the road with a broader gage and install a horse-car service, with the ultimate intention of turning it into an electric line. As it is probable that similar enterprises will be undertaken at other places, there should be a market in the near future for trucks and electric supplies.

TRANSMISSION IN MEXICO.—Mr. Henry W. Catlin, of New York, has organized a new bank at Oaxaca, Mexico, called the Credito Minera de Oaxaca, capital stock $200,000. He has been in Southeastern Mexico for some time and is enthusiastic over the possibilities of that section as to mining and general business. He says that a vast amount of American capital is pouring into that State. "The great problem that has heretofore confronted the Oaxaca field has been that of proper and adequate power for transportation and other purposes. This problem will soon be solved by the erection of a hydro-electric plant at the falls of a river at Tomellin, six miles from the Mexican Southern Railway. American capitalists have obtained a concession for this enterprise and arrangements have practically been completed for the erection of the plant. Transmission lines will be built to various mining camps and industrial centers, covering a radius of more than sixty miles."

LONG ISLAND TERMINAL.—Contracts for the only section of the Pennsylvania Railroad tunnels not already begun have been let. They are for the eastern portals and approaches—in Long Island City—and a short stretch of cut-and-cover tunnel just west of the portals. The job for which contracts are let extends to the end of "Sunnyside Yard," the largest electric car yard in the world. The excavation necessary to the construction of this yard will be as great as that required for the terminal station in Manhattan. Under the East River itself considerably more than 40 per cent of the four iron lined tunnels has been completed. Eight shields are being pushed forward, four from each side of the river. Under Long Island City there is a stretch of 2000 ft. of the four tubes, and in this stretch the excavation is practically finished, and about 85 per cent of the iron lining is in place. Concreting is now under way and is going ahead rapidly.

NEW YORK SUBWAY CONTRACT.—The New York Rapid Transit Commission has awarded the contract for the construction of a section of the subway loop on Centre Street, between Canal and Broome Streets, at its meeting recently. The contract went to the Cranford Company, which was the lowest bidder, for $2,210,000.

HYDRO-ELECTRIC COMMISSION.—Important steps will be taken by the Hydro-Electric Power Commission of Ontario, Canada, in reference to the transmission of the supply of power as soon as the contracts are signed between the interested parties. In the meantime commissioners and counsel are busy drafting the agreements to be entered into between the commission and the Ontario Power Company, and preparing the contracts to be sent to the municipalities. In cases where there is no capital expenditure for distribution involved, the Councils can enter into these contracts without reference to the people. Other municipalities will, it is expected, enter into provisional contracts to be ratified by the people later. As soon as these contracts are signed the commission will call for tenders for the erection of poles and the supplying and stringing of wires for transmission lines from Niagara Falls and also for the construction of transformer stations. The commission will thus have two sets of figures in reference to the cost of transmission. It will be able to adopt a system of transmission at once, when the contracts have been signed. It is hoped that the commission will be able to make an arrangement with the Grand Trunk Railroad Company for the use of the latter's right-of-way for transmission lines from Hamilton to Toronto, from Paris to London, from London to Sarnia and Windsor, and from Woodstock to St. Mary's, Tavistock and Stratford. The wires would serve as trunk lines to feed the points between and in the vicinity of the places named.

CALGARY POWER COMPANY.—The first transmission installation of the Calgary Power & Transportation Company, of Calgary, Alb., will be 5000 horse-power, and as soon as possible that will be duplicated. The power at Horse Shoe Falls, where the company's plant will be built, will have a minimum of 8000 horse-power the year round with an equipment for 12,000, which may be procured for 11 months of the year. The head will be 100 ft., and the construction work will comprise a large concrete dam on a rock foundation. From this point the water will be carried some 500 yards by tunnel, pipe and canal to the power house at the base of a cliff. The company has purchased 1000 acres along the river front from the Stoney Indians, and has secured riparian rights from the Dominion Government. The company proposes to have a railroad station built and communication will be established with the outside world by both telegraph and telephone. The arrangement that exists at the present time between the company and the city of Calgary for lighting is a maximum of $30 per horse-power per annum (10 hours) to individuals and companies with a rebate of 20 per cent to the city. The capitalization of the company is fixed at $1,000,000, and it is being financed in Montreal, Toronto, New York and London, England, but the provisional board of directors comprises a number of prominent Calgary men, who are satisfied that cheap power is the one essential for the progress of a city.

ELECTRIC POWER DISPUTE.—By a decision of the Ontario government, the protracted struggle between the various claimants to the water power at Kakabeka Falls has finally been settled. For years the weird name of the Kakabeka Falls, on the Kaministiquia River, near Port Arthur and Fort Williams, was subject of outcry before the private bills committee of the Ontario Legislature. The controversy was principally between Edward Jenson, the original grantee and his assignees, the Clerque interests at Sault Ste. Marie. Finally the government has decided that the Kaministiquia Power Company, assignee of the Jenson interests, which has gone on developing the falls, shall be confirmed in their right to the Kakabeka Falls. The company must, however, pay the government at the rate of 25 cents a horse-power per year on all power developed in excess of 10,000 horse-power. The provincial authorities, on their part, will build and maintain a dam at Dog Lake for storage purposes. The government will also regulate the flow of all the water from the lake for the dam at Kakabeka Falls. The company has already made several propositions to both Fort William and Port Arthur for supplying power, and now that the government has arrived at a decision the work will be rushed to completion.

SWISS POWER PLANT.—U. S. Consular Agent E. L. Phillips, of Chaux-de-Fonds, writes that the Swiss hydro-electric enterprise of the Lake of Brusio, in the Canton of the Grisons, is without doubt one of the most important upon the Continent, which he thus describes: The water of the River Poschiavo is caught at the base of the Lake Poschiavo, which is used as a controller or regulator for the reservoir and conducted by a 3-mile conduit into the reservoir 1378 feet above the central station. From this reservoir the water is brought into the hydraulic station by means of five conduits fastened in the rocks to a wall nearly vertical. The station now contains six groups of dynamos of 3000 hp each. During this year there will be added four new groups, and in 1908 the two last, which will complete the installation and thereby enable the station to develop 36,000 hp. A portion of this will serve to the needs of the Valley of Poschiavo and the future electric railway of the Bernina. The contractors will reserve for themselves 16,000 kilowatts, and this will be distributed in the industrial region south of the lakes of Como and Maggiore by the means of a circuit 100 miles in length.

MOTOR DRIVEN CRUSHER.—The Georgia Railway & Electric Company, of Atlanta, has had in operation for the past three months, a stone crushing plant for the production of ballasting material for use on its right of way. The machinery installed in this plant comprises a Gates breaker with back gear driving connection; a Gates elevator; a Gates iron frame revolving screen, and four 12 x 18 bin gates, with shafting, pulleys, and belting complete, all built and furnished by the Allis-Chalmers Company, of Milwaukee. The plant, which is located on the electric car line about four miles from the city of Atlanta, is driven by a 60-hp direct-current electric motor operated by power taken from the trolley wire.

UNITED BRASS COMPANY, CLEVELAND, OHIO.—Judging from the number of orders which this company is receiving for its Corcoran wipe joint machine for cable splicing recently put on the market, this device is filling a long-felt want. Among some of the more recent customers are the New York Edison Company, the Brooklyn Edison Company, Rochester Railway & Light Company, Rochester, N. Y.; Southern Bell Telephone & Telegraph Company, Atlanta, Ga.; Chesapeake & Potomac Telephone Company, Washington; Hudson River Telephone Company, Albany, N. Y.; Albany Home Telephone Company, Troy, N. Y., and the War and Signal Departments, at Washington.

STREET CAR RAILS.—In a decision by I. F. Fischer, the Board of United States General Appraisers has overruled a contention raised by W. P. Plummer, of New York, who objected to the assessment of duty imposed by Collector Stranahan on importations of street car rails. The rails were assessed at the rate of seven-twentieths of a cent a pound under the provision in the Dingley tariff for steel rails, and were alleged to be properly dutiable at $4 per ton as scrap fit only to be manufactured. In view of the fact that the rails could be put to use other than as scrap, the board decides that the claim of the importer cannot be sustained.

STURTEVANT APPARATUS.—Mechanical draft equipments furnished by the B. F. Sturtevant Company, of Boston, Mass., are being installed by Atha Steel Casting Company, Newark, N. J.; Columbia Conservo Company, Indianapolis, Ind.; Edison Electric Illuminating Company, Brooklyn, N. Y. The New York Edison Company are installing Sturtevant metal-to-metal joint fuel economizers at Waterside Station No. 2.

RAILWAY CONTRACTS OPEN.—The Mississippi Valley Electric Railway Company will let contracts between June 1 and 15 for 45 miles of grading, approximately 300,000 cu. yds., and is also in the market for ties, poles and general railway equipment. The field office is at Nauvoo, Ill. Address communications to T. R. Smith, principal assistant engineer, Chicago office, 1034 Rookery Building.

TROLLEYS IN TEXAS.—The Galveston-Houston Electric Railway Company has been incorporated under the laws of Texas, with $3,000,000 capital, to build an electric railway between Galveston and Houston, a distance of about fifty miles. The company is being engineered by Stone & Webster, of Boston.

THE AMERICAN LOCOMOTIVE COMPANY, Schenectady, N. Y., is installing an electrically-driven Sturtevant fan to remove smoke from the new running shed. This is practically a duplicate of one previously furnished by the B. F. Sturtevant Company, of Boston, Mass.

ELECTRIC CRANES.—The Edison Illuminating Company, Detroit, Mich., has installed in its Beecher Avenue sub-station a 25-ton electric crane, manufactured by the Northern Engineering Works, Detroit.

NEW WIRE COMPANY.—The Bay State Insulated Wire & Cable Company has just finished its extensive new plant at Hyde Park, Mass., for the manufacture of rubber insulated wires and cables of all kinds and for all classes of service. The factory comprises five buildings on a three-acre property along the banks of the Neponset River, and about 60,000 square feet of floor space is provided. All the equipment of machinery is new and modern, with a daily capacity of over 500,000 feet of covered wire, to which machinery will be added, bringing the outfit up to 1,000,000 feet of finished wire. The power plant comprises a Greene engine of 200 hp, three Roberts & Cunningham boilers of 280 hp and a Knowles pump, etc. The officers and managers of the company are by no means newcomers and novices in the field, but have had a long experience in it, and have actively assisted in its development. The president of the company, Mr. Andrew J. Conlin, is widely known as an expert in the manufacture of wire, having been for the past eighteen years superintendent of the large plant of the Simplex Electrical Company at Cambridge, Mass. Before entering the employ of that company he planned the equipment and installed the machinery of the old Safety Insulated Wire Works. He was also rubber expert and superintendent of the India Rubber & Gutta Percha Wire Company, of Yonkers, N. Y. He will have entire charge of the manufacturing. The treasurer and manager, Mr. John H. H. McNamee, formerly mayor of Cambridge, Mass., is widely known as a capitalist and an energetic, able man, who will bring to the company the executive ability and experience acquired in a successful business life of forty years. The company is now ready for business and desirous of quoting upon any new contracts now offering, in regard to which it invites correspondence.

STAR FIRE ALARMS.—The Star Electric Company, of Binghamton, N. Y., manufacturers of fire alarms, has been reorganized through the efforts of President L. M. Wilson and Secretary B. H. Gitchell, of the Chamber of Commerce. The new officers of the company are: President, T. B. Cray, president of the 1900 Washer Company; first vice-president, C. F. Hotchkiss, president of the Stow Manufacturing Company; second vice-president, William G. Phelps, president of the First National Bank; treasurer, Frank Payne, cashier for the Binghamton Trust Company; secretary, C. E. Beach, superintendent of the manufacturing department of the Star Electric Company; assistant secretary, J. M. Davidge. The board of directors is composed of the above officers and F. W. Welsh and C. J. Knapp. The Star Electric Company has installed extensive fire alarm equipments in Cleveland, Schenectady, Seneca Falls, Binghamton, Niagara Falls, Gouverneur, Kingston, Lockport, Lestershire, Ithaca, Oneonta, and has also sold fire apparatus to numerous other cities.

SOUTHERN PACIFIC TROLLEYS.—It is stated that the Southern Pacific Company and the Huntington interests, which are joint owners of the Pacific Electric Railway, which controls several hundred miles of electric lines in Southern California, have acquired control of the San Bernardino Valley Traction Company and will connect the San Bernardino lines with the Pacific Electric lines at Riverside, Cal. The capital of the Pacific Electric Railway is $20,000,000, of which $10,000,000 is held in the treasury of the Southern Pacific. The San Bernardino Valley Traction Company, which operates thirty-four miles of electric lines in and round San Bernardino, is capitalized at $1,500,000 with an authorized bond issue of $1,000,000. At the close of last year there was outstanding $1,080,000 of the stock and $548,000 of the bonds.

GOVERNMENT CONTRACTS.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, D. C., until June 11, for furnishing supplies at the various navy yards and naval stations as follows: Portsmouth, N. H., schedule 845, tubular boilers; schedule 850, motor drives, forges and fans, blower and engine, Boston, Mass.; schedule 878, trolley hoists, New York, N. Y.; Charleston, S. C., schedule 848, electric traveling crane. Applications for proposals should designate the schedules desired by number. E. B. Rogers, paymaster-general, U. S. N. Bids will also be received by Lieut. Charles C. Burt, acting constructing quartermaster, U. S. A., Fort Worden, Wash., until June 15, for furnishing material and installing fixtures, wiring buildings, making changes in present wiring, making service connections, furnishing and installing watt meters in buildings for electric lighting at this post.

LIGHTING IN CALIFORNIA.—A petition has been filed with the Santa Rosa (Cal.) board of supervisors by Cashier Frank M. Burris, of the Santa Rosa Bank, for a franchise to distribute electricity for lighting, heating and commercial uses all over Sonoma County. While it is not stated, it is believed the Eel River Power Company, which has been developing a plant in Mendocino County for years, is behind the project. The company has converted the entire Potter valley into a mammoth reservoir. To obtain this supply of water a tunnel several miles long is being bored through the mountain to conduct the waters of Eel River into the reservoir. The application for a franchise states that the wires will be strung from the Mendocino County line through Cloverdale, Geyersville, Healdsburg, Lyttons, Windsor, Fulton to Santa Rosa; from Santa Rosa to the west through Kenwood, Glen Ellen and Sonoma to the Napa County line, where it will enter Napa County; and from Santa Rosa south through all the towns to Petaluma, and thence to the Marin County line. Other branches will also be run from Santa Rosa.

ELECTRIC FURNACES.—We are advised that the recently organized American Electric Furnace Company, 45 Wall Street, New York, which took over the business pertaining to electric furnaces carried on by the American Grondal Kjellin Company, New York, and the Induction Furnace Company, Newark, N. J., has acquired all patents relating to electric furnaces taken out by F. A. Kjellin and E. A. Colby which were owned by these companies. The company is prepared to furnish furnaces for the treatment of various metals and alloys. The American Grondal Kjellin Company will continue as heretofore its business relating to the concentration and crushing of ores, etc., developed by Mr. Gustaf Grondal and associates.

HADAWAY HEATING INTERESTS.—The Westinghouse Electric & Manufacturing Company has acquired the Hadaway Electric Heating & Engineering Company and will devote its attention to the manufacture of electric heating devices through that concern. Mr. W. S. Hadaway, Jr., has for some years past made electric heating a special study, and is to be credited with a number of useful devices and successful plants. It is understood that he has always been more or less hampered by lack of capital, but under the new conditions it may be expected that the Hadaway apparatus will take a very prominent place in the field.

CHICAGO ELEVATED.—The Metropolitan Elevated of Chicago has secured a franchise from the town of Cicero to build a 4-mile line from the Western Electric plant on the Douglas Park Branch through to Clyde. The cost will be $25,000 a mile, but the project will not be begun in the near future. Earnings will be at the rate of twice the amount necessary to pay the preferred dividend.

CONEY ISLAND MONORAIL.—The New York Rapid Transit Commission has received a letter from Mr. F. B. Behr accepting the conditions imposed by the Commission and asking it to lay out a route for a monorail system to Coney Island from South Ferry. The letter was referred to the Commission counsel and the chief engineer.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market exhibited some nervousness and was more active than it has been of late. Early in the week there was a violent decline, but prices rallied later on, the advance being general. The early weakness was due to liquidation and renewed short selling caused by a variety of unfavorable circumstances, among which crop conditions and anti-railroad measures, like the Public Utilities Bill in New York, figure to some extent. Rumors of further impending borrowings by railroad companies were also effectual, and public interest was extremely limited. At the close of the week the market developed a considerable amount of strength under the lead of Union Pacific and closed strong at a partial reaction. The announcement that the Master's report in the 80-cent gas litigation was in every respect favorable to the Consolidated Gas Company had a good effect on that stock at first, but this was lost in view of statements that the city authorities would now vigorously press action in regard to the alleged invalidity of the company's franchise. Electric securities with the rest of the list felt the depressing influences, and though there was a general rally the closing quotations were in most cases lower than those of the week previous. Liquidation was the feature

of the week's trading on the curb. Losses of ½ point or more were sustained by many issues, notably the mining group. Following are the closing quotations of May 28:

NEW YORK.

	May 21	May 28		May 21	May 28
Allis-Chalmers Co.	9	9¼	General Electric	140	—
Allis-Chalmers Co. pfd.	27⅛	26⅛	Hudson River Tel.	—	—
Am. Dist. Tel.	—	—	Interborough Met. Com.	19	19
American Locomotive	58	56	Interborough Met. pfd.	53⅜	51
Amer. Locomotive pfd.	105	102	Mackay Cos.	—	—
American Tel. & Cable.	75	78	Mackay Cos pfd.	—	—
American Tel. & Tel.	—	—	Marconi Tel	—	—
Brooklyn Rapid Transit	53	49¼	Metropolitan St. Ry.	—	—
Electric Boat	35	33	N. Y. & N. J. Tel.	—	—
Electric Boat pfd.	82	80	Western Union Tel.	81½	78
Electric Vehicle	—	—	Westinghouse com.	143	142
Electric Vehicle pfd.	—	—	Westinghouse pfd.	—	—

BOSTON.

	May 21	May 28		May 21	May 28
American Tel. & Tel.	123	117½	Mass. Elec. Ry pfd.	—	—
Cumberland Telephone.	—	—	Mexican Telephone	—	—
Edison Elec. Illum.	216	—	New England Telep.	—	115
General Electric	142⅜	137	Western Tel. & Tel.	6½	—
Mass. Elec. Ry.	17	—	West. Tel. & Tel. pfd.	71	—

PHILADELPHIA.

	May 21	May 28		May 21	May 28
American Railways	49	49¼	Phila. Electric	8¼	7⅞
Elec. Co. of America	10	9⅞	Phila. Rapid Transit	23	22¼
Elec. Storage Battery	50	49	Phila. Traction	91¼	91¼
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	May 21	May 28		May 21	May 28
Chicago City Ry.	180	175	National Carbon	71	71
Chicago Edison	—	—	National Carbon pfd.	110	113
Chicago Subway	15⅜	—	Union Traction	—	—
Chicago Tel. Co.	—	—	Union Traction pfd.	—	—
Metropolitan Elec. com.	23	22			

THE WILLIAMS LIQUIDATION.—The creditors of William P. Williams, a promoter who some years ago undertook to construct an extensive electric traction system on Long Island, met last week in the offices of Cassilly Cook, of 60 Wall Street, and organized for the purpose of obtaining a settlement of their claims. Mr. Williams organized the Manhattan-Long Island Railroad Company with an authorized capital of $20,000,000 and the Central Long Island Electric Light & Railroad Company and it was said that it was through these companies that he became indebted to the American Surety Company, J. G. White & Co., the New England Engineering Company, Hugh R. Garden, and Montrose, Clark & Emmons. Mr. Garden said last night that he understood that the total claims against Mr. Williams amounted to about $10,000, Mr. Garden's own claim being about $700 for legal services rendered two or three years ago. Bonds of the Central Long Island Company to the extent of $500,000 it was said yesterday, were floated by Mr. Williams in Washington, D. C., and in New England, but how much, if any, of the $20,000,000 of stock of the Manhattan-Long Island Railroad has reached the hands of the public does not appear. Mr. William's scheme, it was said, was to parallel the Long Island Railroad and he is reported to have received support from residents of Long Island who were desirous of having additional railroad facilities on the island. Outside of obtaining franchises, some of which are said to be valuable, and purchasing right of way, it is understood that very little work has been done on these projected railroads.

BOSTON EDISON EARNINGS.—Data from Boston show the local Edison Company to be very busy. The new business which the company has secured in the past four months is the largest in its history, representing an equivalent of 49,100 16-cp lamps, compared with an increase in business for the corresponding period a year ago of 20,500 16-cp lamps. The net gains in business for the past four months compare as follows:

	1907.	1906.	Increase.
January	$11,800	$4,300	$7,500
February	7,600	*500	8,100
March	12,900	6,300	6,600
April	16,800	10,400	6,400
Total	$49,100	$20,500	$28,600

*Loss.

The lamps and horse-power in motors connected April 30, 1907, compare with connection on June 30 in the years 1906, 1905 and 1904, as follows:

	April 30, 1907.	June 30, 1906.	June 30, 1905.	June 30, 1904.
Incandescent lamps	854,331	788,560	708,384	627,441
Arc lamps	10,302	10,534	10,102	9,358
Horse power	34,073	30,432	26,416	24,150

The total connections on April 30, aggregated 1,478,750 16-cp equivalents, compared with 1,444,363 16-cp equivalents on June 30, 1906. The gross earnings for the year ending June 30 next are estimated to reach not less than $4,160,000.

BALTIMORE MERGER.—The directors of the Baltimore Electric Company, which was organized recently, have elected officers as follows: President, David E. Evans; first vice-president, Sydney L. Wright; second vice-president and general Manager, B. S. Josselyn; secretary, W. T. Spring; treasurer, B. F. Bonsal. The new company is a combination of the Maryland Telephone & Telegraph Company and the Baltimore Electric & Power Co. The company will have a capital of $3,400,000. This, however, represents the $900,000 of the telephone company stock which was owned by the power company and which has been turned into the treasury of the new corporation. The actual stock issue of the new concern, therefore, will be $2,500,000. In addition the directors of the new company have authorized an issue of $1,250,000 of 5 per cent cumulative preferred stock. Of this $1,000,000 will be sold at once. The proceeds, it is understood, will go toward liquidating some floating indebtedness of the consolidated corporations, existing before they were merged.

DIVIDENDS.—The directors of the Denver Gas & Electric Company have declared a dividend of 6 per cent, payable in monthly installments, beginning July 1. The Pensacola Electric Company has declared a semi-annual dividend of $3 per share on the preferred stock, payable June 1. The directors of the Chicago Metropolitan Elevated Company have declared the regular quarterly dividend of ¾ of 1 per cent on the preferred stock, payable June 29. The directors of the Chattanooga Railways Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable June 1. The guaranteed dividend of 1¾ per cent on the stock of the New York Metropolitan Street Railway Company for the current quarter is payable July 1. The directors of the Multiphone Operating Company have declared the regular monthly dividend of 1 per cent, payable June 1.

INDIANA LIGHTING DEAL.—It is announced from Anderson, Ind., that articles of association have been filed by the Central Indiana Lighting Company, with a capital stock of $3,000,000—$2,000,000 common and $1,000,000 preferred. William M. Wherry, Jr., John W. Tobin and Ivan L. Meloon, all of New York, are the incorporators. The Central Indiana Company is a branch of the National Heat, Light & Power Company of New York, which is operating light plants at Taylorsville, Jerseyville, Robinson, Charleston, Paris and Pana, Ill.; Lexington and Marshall, Mo.; Hoosick Falls, N. Y.; Bennington, Twin City and Brattleboro, Vt.

NASHVILLE (TENN.) EXTENSIONS.—The Nashville Railway & Light Company of Tennessee has filed its new refunding and improvement mortgage to the Guaranty Trust Company, of New York, as trustee, to secure an issue of $15,000,000 5 per cent forty-year gold bonds. Of the authorized amount, $2,000,000 is issuable for corporate purposes; $6,000,000 is reserved and can be issued only upon retirement of a like amount of underlying bonds, and $7,000,000 is reserved to be issued at the rate of $1,000 for each $1,250 expended for future improvements.

ST. JOSEPH REPORT.—The St. Joseph (Mo.) Railway, Light, Heat & Power Company reports for the calendar year, ending December 31 last, as follows: Gross earnings, $834,438; operating expenses, $426,803; net earnings, $407,635; all fixed charges, $236,454; balance, $171,181; dividends, $78,000; surplus, $93,181. The company also reports for the four months ended April 30 last: Gross earnings, $261,289; operating expenses, $141,479; net earnings, $119,810; all fixed charges, $79,017; balance, $40,793; dividends. $26,000; surplus, $14,793.

ECONOMY LIGHT BONDS.—The Economy Light & Power Company, Joliet, Ill., is selling $2,000,000 five per cent bonds through the Royal Trust Company. Its capital stock is $3,500,000 and after all charges the past five years it has accumulated a surplus of $330,000. Its president is Mr. Samuel Insull, president of the Chicago Edison Company. The plant hase been in operation twenty-five years, and has a monopoly of the lighting of Joliet.

TELEPHONE CONSOLIDATION.—It appears probable that the United States Independent Telephone Company of Rochester will fight the injunction action recently brought by Attorney-General Jackson for the prevention of the sale of the company to the New Jersey Title, Guarantee & Trust Company of Jersey City, representing the Bell telephone interests. Details of the case have already been given in these pages.

NIAGARA POWER REPORT.—The report of the Niagara Falls Power Company for the year ending December 31, is an encouraging document. The balance sheet is as follows:

Gross earnings	$1,370,308
Operating expenses and reserve ($100,000)	326,124
Net	$1,044,184
Other income	79,400
Total income	$1,123,584
Charges	786,897
Surplus for year	$336,687
Previous surplus	62,534
Profit and loss surplus Dec. 31, 1906	$399,321

The charges are: Interest on the $4,980,000 six per cent debentures (Canadian collateral series A and B) was included in the cost of construction of the Canadian plant up to Jan. 1, 1907, from which date the plant has been in commercial operation. The surplus for the year indicated that 8.03 per cent was on the $4,181,200 capital stock. The combined condensed balance sheet of the Niagara Falls Power Company and the Canadian Niagara Power Company as of December 31, 1906, shows real estate and power house investment, etc., of $21,966,287 and investment securities of $1,500,400. The liabilities included $4,181,200 of capital stock and $18,000,000 of funded debt. President D. O. Mills says in his report: "No additional construction work or installation of generating machinery having been authorized, the company's business must be confined for the present to the output of the plants as they now exist. By direct ownership and through stock control of the Canadian Niagara Power Company (only five shares of its capital stock being held by others), this company now has available for power generation on the American side of the Niagara River two complete plants with an aggregate capacity for an output of about 77,000 electrical horse-power, and a considerable reserve in power generating machinery; an additional capacity of about 8000 hp, of which under leasehold rights 7500 hydraulic hp is now being generated in installations of tenant companies, and on the Canadian side of the Niagara River a plant with installation for a continuous output of 40,000 electrical horse-power, one 10,000-hp generating unit being held in reserve. The cost of construction of this plant has included interest and park rentals to Jan. 1, 1907, from which date it is treated as in commercial operation. From the combined output of these plants, about 95,000 ehp and 7500 hp (leasehold hydraulic rights) now are yielding revenue. Contracts have been negotiated for the sale of additional amounts of electrical power deliverable upon the completion of the installation of the necessary apparatus. It is expected that before the close of 1907 substantially all of the combined output of these plants will become revenue producing. Firm contracts now in force covering long terms will require a considerable part of this power. The remainder, it is believed, will be absorbed quickly by the users of our power steadily increasing in number and requirements. The financial condition of the company never has appeared to be more satisfactory and promising."

U. G. I. REPORT.—President Dolan in the annual report of the United States Gas Improvement Company notes several interesting things. During the fiscal year ended Dec. 31, 1906, the gas companies in which it is interested outside of Philadelphia increased the volume of their sales 13.2 per cent. The sales of the Philadelphia Gas Works increased 6.3 per cent, and the sales of the electric light companies increased 15.3 per cent. The net profits of the United Gas Improvement Company for 1906 were $5,853,327.04, an increase of $783,161.72 over the net profits of 1905. The capital stock was increased during May and June from $36,726,200 to $45,884,850. The earnings of 1906 amounted to 13.49 per cent upon the average capitalization of the year. The property of the Connecticut Railway & Lighting Company has been leased for 999 years from August 1, 1906, and the capital stocks of the Housatonic and New Milford water power companies and of the Meriden, Southington & Compounce Tramway Company have been sold to the Consolidated Railway Company, owned by the New York, New Haven & Hartford Railroad Company, which has guaranteed the fulfillment of the conditions of the lease and payment of the principal and interest of the debentures issued to buy the stocks of the water power companies, and the Meriden, Southington & Compounce Tramway Company. Simultaneously with the above transaction there were sold to the Providence Securities Company, which made payment in its 4 per cent 50-year debenture bonds, guaranteed as to principal and interest by the New York, New Haven & Hartford Railroad Company, all of the bonds and floating debt, and practically all of the capital stock of the Rhode Island Securities Company. By these transactions the U. G. I. Company transferred the responsibility of managing and financing these properties to the New York, New Haven & Hartford Railroad Company, and insured an income to the United Gas Improvement Company from its investments in Connecticut and Rhode Island $1,000,000 per annum, being 4 per cent on securities of the par value of $25,000,000. Since the last annual meeting the following were added to the companies in which the company is interested: The Chester County Gas Company and Dauphin County Gas Company, both doing business in the State of Pennsylvania, the South Bend & Mishawaka Gas Company of the State of Indiana, and the Syracuse Lighting Company, of the State of New York.

NORTH AMERICAN NOTES.—The terms of the $5,000,000 issue of 5 per cent notes of the North American Company taken last week by Lee, Higginson & Company and Redmond & Company have been made known in a statement issued by President Wetmore. In addition to the facts already printed the notes, which are dated May 1, 1907, are redeemable at the company's option on any interest date after May 1, 1909, at 101 and interest. The notes are secured in addition to being a direct obligation of the company by the deposit with and pledge to the Morton Trust Company, of New York, as trustee for the noteholders, of $6,500,000, par value, of underlying electric light and gas stock of St. Louis companies Gas stock, the par value being thirty per cent in excess of the par value of the notes authorized. President Wetmore gives the following statement of the net earnings of the company in 1906 and an estimate of the earnings for 1907: The surplus earnings of the principal companies, in which the North American Company is interested, for 1906, after deducting all operating expenses and dividends paid, amounted to $1,193,984.66. The net cash income of the company for the fiscal and calendar year 1907 is estimated at $1,850,000, or $1,600,000 in excess of the total interest charges upon the entire authorized issue of notes.

CINCINNATI GAS & ELECTRIC.—The stockholders of the Cincinnati Gas & Electric Company elected the following directors: S. R. Burton, J. T. Carew, B. S. Cunningham, J. B. Foraker, Jr., R. A. Holden, C. L. Harrison, Louis J. Hauck, Norman G. Kenan, M. E. Moch, W. C. Proctor, C. H. Rowe, J. G. Schmidlapp, Charles P. Taft, M. M. White and Casimir L. Werk. The directors elected Charles P. Taft as president; R. A. Holden, vice-president, and Theodore Clause, secretary and treasurer. President Taft, in his report, said that since the lease of the company's property to the Union Gas & Electric Company the consumption of electricity had increased 22 per cent. Of the $2,000,000 set aside for improvements, $300,000 has been spent and the company has contracted for $550,000 worth of machinery for the new electric plant, which is to cost $3,000,000 when completed.

GENERAL ELECTRIC BONDS.—President Coffin, of the General Electric Company, has issued a circular letter to stockholders stating the terms upon which subscriptions will be received to the $13,000,000 of convertible bonds. The bonds will be dated June 1, 1907, and may be converted into stock at par after June 1, 1911. The bonds may by called by the company any time after June 1, 1911, upon 90 days' notice at 105 and interest. The bonds will be in $1,000 and $500 denominations. Assignable warrants will be issued as soon as possible after June 20. The right to subscribe expires July 20 and payment of 50 per cent each are to be made on July 20 and Jan. 20, 1908. Full payment may be made on July 20.

KEYSTONE TELEPHONE EARNINGS.—The Keystone Telephone Company, of Philadelphia, reports substantially increased earnings both for the month and for the ten-months period. In April the gross was $87,409, against $70,861 last year. Operating expenses and taxes were $42,529, or only 48 per cent, against $39,947, or 56 per cent, in 1906. For the ten months the gross earnings of $819,890 is an increase of $144,256 over last season, of which increase nearly $85,000 is carried as net income. During the period a reserve fund for renewals amounted to $83,680 has been set aside, compared with $63,089 in the ten months of 1906.

NEW ORLEANS NOTES.—The New Orleans Railway & Light Company has issued $5,000,000 five-year coupon notes for improvements.

GENERAL NEWS

Construction News.

BESSEMER, ALA.—The City Council has authorized the issue of $157,050 in bonds for an electric light plant and other improvements.

ENSLEY, ALA.—An electric railway franchise has been granted by the City Council to H. S. Meade, J. J. Walker, B. R. Pegram and associates.

OAKLAND, CAL.—The Western Power Company, headed by Edwin Hawley, of New York, N. Y., is interested in the construction of a transmission line from the Sierra, and is said to be seeking a location in Oakland for one of the sub-stations.

REDDING, CAL.—The Board of Supervisors of Shasta County has granted a franchise to the Northern Light & Power Company.

SAN FRANCISCO, CAL.—The Sierra Power Company has filed an application with the Board of Supervisors for a franchise to construct and maintain an electric power station for the purpose of supplying electricity for lighting and power in San Francisco.

SAN FRANCISCO, CAL.—Bids will be received by Captain B. Chealham, constructing quartermaster, U. S. A., 1086 North Point Street, San Francisco, until June 14 for installing a complete electric lighting system and furnishing electricity for illuminating and small motor purposes for Fort Baker and Barry, Cal.

TRINIDAD, COL.—It is stated that Westinghouse interests have obtained a three months' option on the Trinidad Electric Railway; the Trinidad Light, Power & Manufacturing Company, the Walsenburg electric light plant and other electrical plants in southern Colorado and northern New Mexico, and is planning to establish a large plant to supply electricity for light and power to all the camps and towns in southern Colorado and northern New Mexico. The County Commissioners have granted a 25-year franchise to C. L. Hendershot, who is acting for the company, for the erection of poles and transmission lines over all the county roads.

BRIDGEPORT, CONN.—The Singer Manufacturing Company is building a large central power plant at the Wheeler & Wilson plant which will supplant four independent steam power plants now in use. The plant will furnish electricity for lighting and power for the various factories. The power house will be equipped with a battery of eight boilers and will have a capacity of 2000 horse-power.

DANBURY, CONN.—The new hat factory of the Peix-Maclachlan Company, which will soon be put in operation, will be equipped entirely with electrical machinery.

NEW HAVEN, CONN.—The East Haven Telephone & Electric Company has filed notice with the Secretary of State of an increase of capital stock from $3,000 to $5,000.

WASHINGTON, CONN.—The State Legislature has passed a bill incorporating the Washington Electric Light & Power Company.

WASHINGTON, D. C.—Arrangements are being made by the Capital Traction Company to improve its power plant on Grace Street, which will involve an expenditure of about $25,000.

MACON, GA.—City Electrician C. H. Humphreys has prepared estimates for an electric light plant for the city, to furnish 500 arc and incandescent lamps, which, he states, would cost about $75,000.

MADISON, GA.—Bids will be received until June 6 by Col. E. W. Butler, Mayor, for constructing water works and sewerage system and improving the electric plant. Two bids will be considered, one for furnishing materials and labor for construction, and the other for labor only, the city to furnish all the materials. Equipment for water works will consist of 100,000-gallon reservoir, two compound duplex pumps of 500,000 gallons capacity, two centrifugal pumps of 200 and 300 gallons capacity per minute, driven by two alternating-current motors and one 125-hp boiler. Machinery for the electric plant will consist of one 100-kw, 60-cycle, three-phase, 2300-volt alternator and a 125-hp plain slide-valve engine. E. H. Davis, of Griffin, Ga., is the engineer.

SAINT MARIES, IDAHO.—F. A. Johnson, of Butte, Mont., has applied to the Village Trustees for a franchise to establish an electric lighting and power plant in this place.

ATWOOD, ILL.—The City Council is considering the question of constructing a municipal lighting plant.

HILLVIEW, ILL.—Bids will be received until June 4 by Louis Lowenstein for constructing a power house and pumping station.

PEORIA, ILL.—Plans are being made by the Peoria Gas & Electric Company for extensive improvements to its plant and system in this city, which will involve an expenditure of about $300,000. Plans and specifications are being prepared for the new underground conduit system, for which contracts for construction will soon be awarded. Emil G. Schmidt is manager.

SPRINGFIELD, ILL.—The St. Louis, Decatur & Champaign Railway Company and the Peoria, Bloomington & Decatur Railway Company have each increased their capital stock from $5,000 to $500,000.

ALEXANDRIA, IND.—The Central Indiana Lighting Company has purchased the plant and holdings of the Fairmount Light & Power Company, for which it paid $20,000.

BLOOMINGTON, IND.—The People's Light, Gas, Heat & Power Company's property has been transferred to the National Light, Heat & Power Company, with I. L. Meloon, of New York, as general manager. The first improvements will be the erection of a new building, the adoption of a day service to include the city and quarries, and the installation of an 800-hp boiler. This plant is one of the four the National Company has recently acquired in this State.

CLAY CITY, IND.—The Clay City Electric Light Campany's plant was destroyed by a boiler explosion on May 22, causing a loss of $10,000. The plant will be rebuilt and re-equipped at once.

COLUMBUS, IND.—It is authoritatively stated that the Central Indiana Lighting Company has an option on the holdings of the Columbus Street Railway & Light Company. It is said that the lines of the street railway will be extended, a new power plant built and a central heating plant will be installed.

INDIANAPOLIS, IND.—The State Board of Agriculture has decided to construct a water works, electric light and heating plant at the State Fair Grounds to cost $10,000.

LIGONIER, IND.—The City Council entered into an agreement with the Ligonier Electric Company whereby the company is to continue the present lighting service until July 1, 1909. The Council refused to grant the company a new franchise, as the question of establishing a municipal electric plant is now under consideration.

CANTRIL, IA.—Engineer E. E. McKee, of Cantril, writes that bids will probably be called for in the fall for the proposed electric light plant, which will cost from $4,000 to $5,000.

DES MOINES, IA.—The Des Moines Mutual Telephone Company has filed amended articles of incorporation, increasing its capital stock from $450,000 to $1,600,000. The increase in capital is for the purpose of taking over and consolidating five outlying mutual systems, among which are the Hawkeye Telephone Company, with headquarters at Dallis; the Boone County Telephone Company, of Boone; the Jasper County Telephone Company, which extends from Colfax, eastward, to Grinnell; the Iowa Southern Telephone Company, of Des Moines, and the Knoxville Electric Company, of Knoxville.

NEW HAMPTON, IA.—Bids will be received until June 2 by B. F. Strike, City Clerk, for furnishing material and erecting a power house for the combined electric light and water works plant.

SIDNEY, IA.—The City Council has ordered a special election to be held June 10 to vote on the question of granting a 25-year electric light franchise to E. B. Hillman, of Quincy, Ill. If the franchise is granted electricity will be transmitted by means of a high-tension line from Hamburg, a distance of 12 miles.

FORT SCOTT, KAN.—The Fort Scott Gas & Electric Company will commence work at once on improvements to its plant, which will involve an expenditure of $20,000.

TOPEKA, KAN.—The City Council has decided to hold an election to vote on the proposition to issue bonds to the amount of $65,000 for the reconstruction of the municipal electric lighting plant.

TOPEKA, KAN.—Bids will be received by the State Board of Control until June 8 for furnishing and setting at the State Hospital a direct-connected unit, consisting of an alternating-current, 2200-volt generator and engine; also a pole line, a motor and a 1,000,000-gallon triplex pump. For further information address the secretary, State Board of Control.

LOUISVILLE, KY.—As a result of a recent decision of the Court of Appeals, upholding the franchise ordinance under which the Kentucky Electric Company secured its rights, the company will commence work very soon on the construction of its plant in this city. Bids are now being received for the construction of the power plant. Arrangements are also being made for placing contracts for the equipment of the plant, which will cost about $800,000. It is expected to have the plant in operation about June 1, 1908.

FRANKLIN, LA.—Plans and specifications for the new municipal electric light plant have been adopted by the City Council. The estimated cost is $30,000. The new plant will be twice as large as the present one and the old incandescent street lamps will be changed to arc lamps.

NEW ORLEANS, LA.—The New Orleans Railway & Light Company has issued $5,000,000 in bonds, the proceeds of which will be used for improvements.

PORTLAND, ME.—The State Railroad Commissioners have approved the petition of the Portland & Northern Railroad Company to construct an electric railway from Portland to Bridgton. The road will be 40 miles long. The company is capitalized at $160,000, and William M. Sturges, N. D. Sturges, of Scranton, Pa., and Tracy W. Holland, of New York, N. Y., are the principal stockholders.

BALTIMORE, MD.—The Baltimore Electric Company has conveyed to the Maryland Telephone Company all its rights, privileges and franchises to do a telephone business and all property in the county used in conducting the business. The Baltimore Electric Company is a consolidation of the Maryland Telephone & Telegraph Company and the Baltimore Electric Power Company and was incorporated in 1904.

SALISBURY, MD.—The Salisbury Light, Heat & Power Company has been purchased by a syndicate of Salisbury capitalists. The directors of the new company are M. V. Brewington, president; S. A. Graham, secretary-treasurer; George T. Houston, Samuel R. Douglas, William J. Downing, William M. Cooper and R. R. Rhodes. The present contract price for street lighting is $60 a year per arc lamp and $9 a year each for 24-cp incandescent lamps.

ABINGTON, MASS.—The Electric Light & Power Company, of North Abington and Rockland, is extending its lines to Loud's Corner, where the factories of William S. O'Brien and Charles H. Daly are to be equipped with motors and operated by electricity. Both plants are now run by gasoline engines.

BOSTON, MASS.—The Springfield & Eastern Street Railway Company has applied to the State Railroad Commissioners for permission to issue $75,000 additional stock to pay for the extension to Fiskdale and to increase the capacity of the power plant and for other work.

FRANKLIN, MASS.—The Selectmen are making arrangements to contract with the Union Electric Light Company to light the streets of the town for a term of five years. A better service will be demanded, which will require an expenditure of a large amount of money. It is said the company will have to operate its system from its large plant in Woonsocket, or practically rebuild the local plant, before a better service can be furnished.

MARLBORO, MASS.—The property and holdings of the Marlboro Electric Company has been purchased by a new company, of which Wallace G. Webber, of Allston, is president, and William H. Emory, of Boston, who will be treasurer. William N. Davenport and Louis P. Howe, members of the old company, will be in the new company as directors, and Mr. Howe will continue to act as treasurer until the new company organizes permanently. The new company will continue to use the name of Marlboro Electric Company, and it is said contemplates making extensive improvements and extensions of service. The company is planning to extend its lines to Northboro, and arrangements are now being made with the town officials of Northboro to light the town.

REVERE, MASS.—The citizens on May 13 voted to authorize the Municipal Light Board to enter into a contract with the Suburban Gas & Electric Company for lighting the streets of the village for a term of five years. The present lighting system consists of 142 arc lamps and 170 incandescent lamps, which the company agrees to furnish for the sum of $15,683.50 per year, a reduction of $666.50 per year from the amount now paid, and also agrees to furnish free of charge either gas or electricity (at the town's option) for lighting the public buildings. The company will furnish additional arc lamps as may be desired at $88 each per year, and incandescent lamps at $18.75 each per year, making a reduction of $2 on arc lamps and $2.25 on the incandescents. The company also agrees to reduce the commercial rate for electricity from 17 cents per kw-hour to 16 cents per kw-hour Jan. 1, 1908. The new contract will take effect June 1.

ROCKPORT, MASS.—At a recent town meeting the citizens voted to renew the contract with the Gloucester Electric Company for lighting the town for a term of five years. The company agrees to furnish 171 incandescent lamps of 125 candle-power at $14 each per year and 38 summer lamps for $178.08; also eight arc lamps at $70 each per year, making a total cost of $2,991.08 per year; or 181 incandescent lamps and 38 summer lamps for $2,700 per year. The company will also furnish electricity for lighting the public buildings free of charge to the amount of $350, also furnishing the lamp in front of the town hall free of charge and wiring the town farm free of cost. The town reserves the privilege to terminate and cancel the contract at any time when it may see fit to establish its own lighting plant.

CHARLOTTE, MICH.—The Charlotte Electric Light Company has submitted a proposal to the City Council for lighting the city. The company agrees to furnish electricity at the yearly rate of $72 per arc lamp for a term of three to five years, with the provision that in case a high-tension power company comes into the city before the expiration of the proposed contract the company asks the privilege of purchasing electrical energy from the power company and selling the same to the city at a reduction in proportion to the saving the electric light company would realize in buying the power instead of manufacturing it.

HOLLAND, MICH.—A special election will be held June 10 to vote on the proposition of bonding the city for $30,000 for the purpose of increasing the capacity of the municipal electric lighting plant.

LANSING, MICH.—The Electric Light and Water Board has decided to furnish electricity to small concerns about the city where the Michigan and Commonwealth companies have refused to extend their lines at the regular lighting rates. This action was due to the Michigan Power Company discontinuing its lighting business where its charter does not permit it to operate.

LAPEER, MICH.—The Schlegel Light & Power Company will supplement its water power with a steam plant, in order to provide against any possible failure in its service. The company proposes to institute a 24-hour service, and is making a thorough canvass of the city demonstrating the economical advantages of electricity for cooking, heating, power, etc.

AITKEN, MINN.—The Aitken Power & Light Company is considering the development of water power for electric light and power purposes.

COLERAINE, MINN.—Fairbanks, Morse & Company, of St. Paul, have secured the contract for installing the electric lighting plant in the John C. Greenway School.

FERGUS FALLS, MINN.—Vernon A. Wright, of Fergus Falls, writes that the contract has been let for the proposed dam at Dayton for power purposes.

MANKATO, MINN.—The stockholders of the Mankato Citizens' Telephone Company have voted to increase the capital stock of the company from $100,000 to $150,000, which will enable the company to make several extensions into the country.

MARSHALL, MINN.—An election will soon be held to vote on the proposition of issuing $17,000 in bonds for additions and improvements to the electric light plant.

ST. PAUL, MINN.—The Board of Public Improvements has been informed by Comptroller Player that there is no money available to erect a municipal electric lighting plant. The only way to secure the funds necessary to erect the plant would be by a bond issue, approved by two-thirds majority of the voters of the city. From $2,500,000 to $3,000,000 would be required to erect a plant.

CANTON, MISS.—Extensive improvements and additions to the municipal electric lighting plant are now under consideration, which will be made during 1908. The system will be changed from 60 to 133 cycles, and the present machines will be replaced by a direct-connected outfit. John T. Sharp, Jr., is manager.

LAUREL, MISS.—The Gulf States Investment Company, which owns and operates the local electric lighting plant, has applied to the City Council for a franchise to construct and operate a street railway system in this city.

LELAND, MISS.—The City Council has authorized the issuance of a small amount of bonds here to improve the electric and water plants.

JEFFERSON CITY, MO.—Application for a charter has been filed by the Jefferson City & Pittsfield Railroad Company in Jefferson City and Topeka, Kan., for permission to build and operate an electric railway in southern Missouri and eastern Kansas. The company is capitalized at $5,000,000. J. J. Heim, of Kansas City, is the promoter.

HELENA, MONT.—The Helena Light & Railway Company is planning to award contracts for the construction of several extensions of its lines during the next six weeks.

AUBURN, NEB.—Plans have been prepared for the Auburn Telephone Company for the construction of a new telephone building in this city, which will cost $4,000.

FRIEND, NEB.—The Northwestern Electric Company, of St. Paul, Minn., has secured the contract for furnishing all the electric equipment, installing all poles and lines on the electric lighting system in this city for $6,629.

LINCOLN, NEB.—G. O. Loomis is now the owner of the Lincoln Sign Works, having purchased the interests of others in that business. The company will make a specialty of electrical signs along with its general sign work.

OMAHA, NEB.—H. E. Babcock, of Columbus, Neb., is interested in the construction of an electric power plant, utilizing the water power of Loup and Platte Rivers.

CARSON CITY, NEV.—The California-Nevada Electric Power Company has purchased of T. B. Rickey, of Carson City, 15,000 acres of land in Alpine County with water rights enough to furnish water power for the large enterprise. The company proposes to construct an electric railway from Reno, Nev., to Los Angeles, Cal., and is now constructing a large power plant near Gardenville. F. G. Baum is consulting engineer of the project.

NEVADA CITY, NEV.—The Bay Counties Power Company has commenced work on the erection of its transmission line from the power house in Rome on the South Yuba River to the Alaska mine, near Pike City, a distance of about ten miles. The line will probably be extended to Alleghany and Forest.

RENO, NEV.—The Reno Traction Company has filed a mortgage in favor of the Central Trust Company of California to secure an issue of $1,000,000 in bonds, the proceeds to be used for general improvements which the company is planning to make throughout its system.

ASBURY PARK, N. J.—The Atlantic Coast Electric Railway Company is contemplating the purchase of a 500-kw Westinghouse turbo-generator set next fall so as to increase the capacity of its plant to provide for increase of business during the summer.

MORRISTOWN, N. J.—The Board of Aldermen on May 22 voted to give the street lighting contract to Peter V. Stryker, of Bernardsville.

PATERSON, N. J.—A committee of the Board of Freeholders has been appointed to make some arrangement with the Public Service Corporation whereby cheaper rates for lighting the county roads may be secured. Under the existing contract the county pays $140 for every arc lamp wherever placed in the county and as many of the lamps are placed within the city limits, the board thinks it should get the benefit of city rates.

PATERSON, N. J.—The Board of Public Works on May 21 entered into a contract with the Public Service Corporation, whereby the company agrees to furnish this city with arc lamps for street lighting at $7.50 per lamp per year for a term of seven years, and to light all public buildings with electricity at a flat rate of 8 cents per kw-hour. The new contract will go into effect July 1. It also contains a provision that after Jan. 1, 1908, the company shall charge 10 cents per kw-hour for electricity for incandescent lamps. It is estimated that $40,000 will be saved by the city during the two years the old contract had to run.

PHILLIPSBURG, N. J.—The Common Council has passed an ordinance granting a 20-year franchise to the Easton Traction Company for the right of way for the construction of a five-mile extension to present railway system in the town.

SECAUCUS, N. J.—Bids will be received by the Board of Chosen Freeholders until June 6 (readvertisement) for wiring and installation of an electric lighting system in the new County Almshouse at the County Farm, Secaucus. Walter O'Meara, Jersey City, is clerk.

SUMMIT, N. J.—At a special election held recently the citizens voted to grant a franchise to the Morris County Traction Company for the extension of its lines to this place. The franchise is for a term of 40 years.

BROOKLYN, N. Y.—Bids will be received until June 3 by C. B. J. Snyder, superintendent school buildings, New York City, for installing electrical equipment in school No. 152, Borough of Brooklyn.

CANANDAIGUA, N. Y.—The Ontario Light & Traction Company is planning to make extensive repairs and improvements to its plant, which will involve an expenditure of about $30,000. The company now furnishes electricity for lighting Canandaigua, Shortsville and Manchester.

LONG ISLAND CITY, N. Y.—Bids will be received until June 3 by C. B. J. Snyder, superintendent school buildings, New York City, for additions to and alterations in electric equipment at schools Nos. 20, 23 and 47, Borough of Queens, and installing electric equipment in addition to school No. 39, Far Rockaway, Borough of Queens.

GENEVA, N. Y.—Negotiations are under way by which the Geneva-Seneca Electric Company will pass into the control of the Empire Coke Company, of this city. The electric company furnishes Geneva, Seneca and Waterloo with electricity, while the Empire Coke Company supplies gas to the above places and also to Auburn.

NEW YORK, N. Y.—Bids will be received until June 3 by C. B. J. Snyder, superintendent school buildings, for installing electrical equipment in school No. 12, Borough of Manhattan. Bids will also be received until June 10 by C. B. J. Snyder, superintendent school buildings, for installing electric equipment in additions to and alterations in School 41, Borough of Manhattan.

NIAGARA FALLS, N. Y.—Bids will be received by Edward H. Perry, superintendent State Reservation, until June 21 for an outside electric lighting system at the State Reservation at Niagara Falls.

HIGH POINT, N. C.—D. Allen and associates have been granted a franchise by the City Council to construct and operate an electric car line in High Point and an interurban line between High Point, Winston-Salem, Thomasville and Greensboro. The company will also maintain and operate an electric light and power and gas plant.

NEWBERN, N. C.—Arrangements are being made to turn over the municipal electric lighting plant to a private corporation. The plant has been operated by the city for ten years and has proven a failure.

ROCKY MOUNT, N. C.—Bids will be received until June 6 by W. L. Thorp, mayor, for $155,000 in bonds for various improvements, including the lighting system.

CHESTERHILL, OHIO.—The capital stock of the People's Telephone Company has been increased from $15,000 to $20,000.

CINCINNATI, OHIO.—Surveys are now being made for the Cincinnati & Middletown Traction Company, which will be completed in about two months, when work on the construction of the road will commence.

COLUMBUS, OHIO.—Sealed bids will be received until June 7 for furnishing materials for electric wiring of the basement of the state capitol. A. B. Critchfield, adjutant-general.

COLUMBUS, OHIO.—Bids will be received until June 21 by the Board of County Commissioners (John Scott, clerk) for furnishing material and doing the following work at the Franklin County Court House: Electrical wiring and fixtures for court house; furnishing electricity for light and power purposes, and electric lamps for the fixtures and maintaining the same. Lighting companies will be required to bring in from the source of supply underground service wires from the lot line to basement. Contracts for light and power to run for a period of five years.

COLUMBUS, OHIO.—Bills will be received until June 4 (re-advertisement) by the Board of Public Service for furnishing material and installing additional machinery for the municipal electric light plant as follows: One high-pressure condensing steam turbine of ample capacity and adapted for direct connection to a 1000-kw generator under normal load conditions; one turbine type alternator, stokers for two 300-hp water-tube boilers, with the necessary machinery; fuel economizers for two 300-hp water-tube boilers; 6000 ft. 5/8-in. steel rod for mast arms; 5000 ft. 1¼-in. steel pipe for mast arms; an extension to switchboard gallery, 11 ft. 6 in. wide x 9 ft. long. Edward F. McGuire is secretary.

DAYTON, OHIO.—The Home Telephone Company has filed a certificate with the Secretary of State increasing its capital stock from $1,200,000 to $2,000,000.

HARRISON, OHIO.—V. F. Chambers, receiver of the Harrison Water & Light Company, has reported to Judge Warner of the sale of the property and franchise of the company to Charles A. Hinch, president of the Fifth National Bank, for $21,900. The property was appraised at $32,775.

MARION, OHIO.—The Columbus, Marion & Delaware Electric Railway Company has been granted a franchise by the County Commissioners to construct its electric railway along the Marion-Bucyrus road from the city line to the Crawford County line.

THURSTON, OHIO.—The Buckeye Lake Home Telephone Company has filed a certificate with the Secretary of State showing an increase of its capital stock from $10,000 to $30,000. The company will extend its lines and improve its system.

TOLEDO, OHIO.—The State Board of Charities has approved the plans for the erection of a power and heating plant at the County Infirmary, to cost $27,000.

TOLEDO, OHIO.—The Board of Public Service has decided to contract with the Toledo Railways & Light Company for 24 arc lamps for the city parks at $33 each for five months' service.

ALLENTOWN, PA.—At a recent meeting of the City Council a special committee was appointed to investigate the cost of lighting the city with electricity and gas.

MILLVALE, PA.—The Borough Council has decided to submit to the people the question of issuing $20,000 in bonds to increase the capacity of the municipal electric light plant.

PITTSBURG, PA.—The power house of the Pittsburg Railways Company, at Glenwood, was considerably damaged by fire recently, the loss being about $20,000.

SCRANTON, PA.—Plans are under way for the construction of an electric railway from Montrose to Wyalusing. Application will soon be made to the Governor for a charter by T. J. Davies, M. S. Allen, J. S. Courtright and W. D. B. Ainey. The road will be known as the Wyalusing Valley Railway.

WESTERLY, R. I.—The Westerly Power Company is planning several extensions to its lines and lighting system. About 15 miles of wire has been received for the new transmission line to Stonington, and when completed the borough will be lighted from the Westerly plant. The company will also replace the system now in use in Watch Hill with the three-phase system this year, and will also extend its pole line to Ashway as soon as the line to Stonington is completed. The company has also received 14,000 lbs. of feed wire for the Pawcatuck Valley road.

SPARTANBURG, S. C.—The City Council is contemplating making a contract with the Dravo Electric Power Company to furnish electricity in the city for street and private lighting. The Dravo Electric Power Company is developing a plant on Broad River and will be ready for business the first of next year. Under the arrangements now being considered the city will control the lighting system.

CORSICA, S. D.—John Absher, of Wagner, has secured a franchise for an electric light plant.

CHATTANOOGA, TENN.—It is reported that the Chattanooga Southern Railroad will be turned into an interurban railway, and will be operated by electricity when the Hale's dam power plant is completed. The proposed plant will have a capacity of 50,000 horse-power.

AUSTIN, TEX.—The Austin Electric Railway Company is making arrangements to increase the capacity of its power plant and is in the market for a 300 to 350-kw direct-current, 500-550-volt, direct-connected railway unit and a compound condensing engine.

HEMPSTEAD, TEX.—The County Commissioners have granted J. C. Amsler a franchise for an electric light plant.

HEREFORD, TEX.—At a recent meeting of the City Council a franchise was granted to Tucker & Jacobsen to install an electric lighting system in this place.

HOUSTON, TEX.—The stockholders of the Houston-Galveston Interurban Company have authorized an issue of $5,000,000 in bonds. Construction work on the road will commence at an early date.

SAN ANTONIO, TEX.—Contracts will soon be placed by the San Antonio Traction Company for construction of the extension of its line to Alamo Heights.

SEGUIN, TEX.—Improvements and additions are being made to the municipal electric lighting plant, which will involve an expenditure of about $10,000. K. V. Boeckman is superintendent.

TEMPLE, TEX.—The litigation which existed between various parties at interest involving the ownership and control of the Temple Waterworks Company and the Temple Electric Light Company has been amicably settled and a compromise effected which removes the case from the jurisdiction of the courts. Reorganization of the properties has been effected. The electric light company elected the following officers: J. Z. Miller, Jr., of Belton, president; J. Z. Miller, Jr., III., of Belton, secretary; J. E. Ferguson, of Temple, treasurer. The city of Temple several months ago decided by an election to own and operate a water works system, and negotiations have been in progress for some time looking toward the purchase of the present plant. If no satisfactory understanding as to price can be reached the city will proceed to construct a modern municipal plant, which will also furnish electric light.

OGDEN, UTAH.—The Ogden Rapid Transit Company has recently purchased a 400-hp motor generator of the General Electric Company.

SPRINGFIELD, VT.—Preparations are being made by the Fellows' Gear Shaper Company for the construction of a new power house.

FREDERICKSBURG, VA.—S. E. Eastburn, city clerk, writes that W. H. Trafford, of Richmond, is preparing plans for an electric light plant which will cost about $40,000. It has not been fully decided to construct the plant. E. W. Mills is chairman of the committee.

FORT WRIGHT, WASH.—Bids will be received until June 11 by Captain Edward A. Shuttleworth, quartermaster, U. S. A., for furnishing and installing fixtures for electric lighting in the new addition to the hospital at this post.

INDEX, WASH.—The Nonpareil Copper & Development Company has awarded the contract for the equipment and machinery for a new lighting and power plant to the Ideal Electric & Manufacturing Company, of Mansfield, Ohio.

CHARLESTOWN, W. VA.—Arrangements are being made by the Charlestown Light & Power Company to operate its system by electricity from the power plant of the Winchester & Washington Electric Railway Company at Millville. For the present the local plant will be held in reserve for use in case of emergency. The local plant also furnishes electricity for lighting the streets of Berryville.

BLACK RIVER FALLS, WIS.—The Central Wisconsin Telephone Company has increased its capital stock from $50,000 to $100,000.

KAUKAUNA, WIS.—The Green Bay & Mississippi Canal Company has awarded the contract for the construction of its power plant at Kaukauna to O'Keefe & Orbison, of Appleton, the plant to cost completed $60,000. The proposed new power house will be located on the site of the old Badger paper mill and will have a capacity of from 2000 to 2200 horsepower, which will be used for motor purposes only, the greater portion of the capacity of the plant having already been leased.

LA CROSSE, WIS.—The La Crosse Water Power Company expects to have its plant completed and to furnish electricity in La Crosse and Winona by Dec. 1. The plans for the construction of the power house are nearly completed, and the contract for the electrical work has been awarded to the General Electric Company, of Schenectady, N. Y., at a total cost of $125,000. The equipment consists of two 4000-hp generators and two 250-hp wheels for the exciter in the power house. The generators will be direct connected to 4000-hp water wheels, which will be furnished by the S. Morgan-Smith Company, of York, Pa. The electrical contract includes the transformers for the sub-station to be located at La Crosse and Winona, with all necessary lightning arresters and high-tension switches.

MILWAUKEE, WIS.—Specifications calling for a municipal electric lighting system of 3000 lamps was submitted to the Board of Public Works and the advisory committee of the Common Council. The number of lamps is about twice the number that was originally figured on, and one generating unit is to provide for commercial lighting. The cost of the gas producing plant is estimated at $96,855, and the gas engine electric plant at $397,045. Bids for the equipment of the plant will probably be received about July 1. Charles J. Poetsch is city engineer.

CALGARY, ALBERTA.—At a recent election the citizens voted to issue $120,000 in bonds for the construction of a municipal telephone system.

PORTAGE LA PRAIRIE, MAN.—The International Lighting & Heating Company, of Cleveland, Ohio, which company recently received a franchise from this city, has purchased a site and will at once install a plant.

BRANDON, ONT.—The Brandon Electric Light Company is making arrangements to increase the capacity of its power plant and has secured a permit for the erection of a building to cost $21,000, work on which will commence at once.

PORT ARTHUR, ONT.—A company is being formed here to build an electric smelter at a cost of over $1,000,000. E. B. McKay can give particulars.

PORT ARTHUR, ONT.—The City of Port Arthur has applied to the Hydro-Electric Power Commission for the right to develop the water power at Dog Lake Falls, on the Kaministiquia River. The city made application to the commission for 2250 kilowatts of electric power and the government has decided to build a storage dam at Dog Lake, which will regulate the flow of water at various powers on the stream. The city also wishes to operate at Dog Lake Falls, which is capable of producing 30,000 horse-power.

ST. CATHERINES, ONT.—The St. Catherines & Toronto Railway Company is extending its lines from Fonthill to Welland, a distance of five miles, and is also contemplating building an extension to its power house located at Thorold. The company is in the market for two 500-kw rotary converters and 16 semi-convertible cars.

TORONTO, ONT.—The Board of Control has instructed the city engineer to make estimates of the cost of a distribution plant for electric power and also to report on the best location for such a plant. The estimates will be based on the city's taking 15,000 horse-power.

TORONTO, ONT.—The Hydro-Electric Power Commission has received an offer from the New York & Ontario Power Company, which is located at Waddington on the New York side of the St. Lawrence River, to supply it with electrical energy. The company is able to produce about 33,000 horse-power, and its charter permits it to dispose of a portion of its output on the Canadian side. This offer makes a supply of electrical energy available for Kingston and vicinity.

MONTREAL, QUE.—Sealed tenders will be received by David Seath, secretary of the Montreal Board of Harbor Commissioners, until June 5, for telephone equipment, signal lamps, and electrical equipment for the new grain elevators.

PRINCE ALBERT, SASK.—W. S. Weeks & Company have made application to the City Council for a street railway franchise.

REGINA, SASK.—The ratepayers voted against granting a franchise to the International Lighting & Heating Company, of Cleveland, Ohio. It is understood the system will be installed by the city and run under municipal ownership. Address J. M. Smith, mayor.

SASKATOON, SASK.—C. H. Mitchell is preparing plans and estimates for the development of electrical power in the river at this place. He states that with a head of 15 ft. 4000 electrical horse-power can be developed.

Company Elections.

TRAVERSE CITY, MICH.—At the annual meeting of the Electric Land & Development Company, held recently, the following officers were elected: Dan J. Albertson, president; Liew P. Haskins, first vice-president; Stephen Lautner, second vice-president; W. H. Umler, secretary; A. W. Bartak, treasurer.

MEMPHIS, TENN.—At the annual meeting of the Memphis Telephone Company held recently the following directors were elected: A. B. Thrasher, M. J. Richmond, B. A. Adams, Robert M. Trimble, U. J. Howard, George A. Howard and Harvey Myers.

ELGIN, TEX.—At a special meeting of the Elgin Water & Light Company the following officers were elected: W. H. Rivers, president; P. Bassist, first vice-president; T. B. Taylor, second vice-president; J. C. Orgain, secretary-treasurer. The directors are: W. H. Rivers, J. C. Miller, J. C. Orgain, Carl Carlson, C. A. Selstrom, T. B. Taylor and P. Bassist. Judge Charles W. Webb was elected general attorney for the corporation. The secretary, under instruction of the board of directors, was instructed to apply for a charter. The company is capitalized at $50,000.

New Industrial Companies.

THE BRADSHAW ELECTRIC COMPANY, of Charlotte, N. C., has been granted a charter, with a capital stock of $50,000. The incorporators are: C. E. Bradshaw and others. The company will engage in the business of electrical and mechanical engineering.

THE ELECTRICAL APPLIANCE COMPANY, of Dallas, Tex., has been incorporated, with a capital stock of $10,000. The incorporators are: Willard S. Low, Thos. I. Stacey and N. B. Traylor.

THE ELECTRIC RUBBER COMPANY, of Newark, N. J., has been incorporated with a capital stock of $1,000,000. The incorporators are Oscar C. Miller, Walter H. Bond and William Conkling.

THE EQUILIBRIUM VALVE ENGINE COMPANY, of Brooklyn, N. Y., has been chartered with a capital stock of $10,000. The directors are W. L. Murphy, H. W. Fuller, and E. A. Andrews, of Brooklyn, N. Y.

THE LEE & BELLMER COMPANY, 38 Beaver Street, New York. N. Y., has been chartered with a capital stock of $10,000 for the purpose of manufacturing electrical supplies. The directors are W. I. Lee, Hackensack, N. J.; E. F. Bellman, New York; Frank Hamilton, Jamaica, L. I., N. Y.

New Incorporations.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed with the Secretary of State for the San Francisco Railway & Power Company with a capital stock of $1,000,000. The incorporators are B. F. Clarke, F. C. Boekmann, George K. Ford, George E. Bennett and J. R. Sloan.

LOS ANGELES, CAL.—The Port Orange & Santa Anna Railway Company has been organized to construct an electric railway to connect this city with the Newport Railway. The incorporators are: Frank F. Johnson, Walter G. Hopkins, Joseph Fletcher and others.

WILLOWS, CAL.—The Snow Mountain Power & Light Company has been formed by Charles Glenn, C. R. Wickes and Albert Lundstrom for the purpose of constructing a power plant on Stony Creek, about three miles from Stonyford. The plant will have a capacity of about 20,000 hp. The company has applied to the Supervisors of Colusa County for a franchise to erect transmission lines for the distribution of electricity for lighting and power purposes throughout the county.

CHICAGO, ILL.—The Northwestern Illinois Gas & Electric Company has been incorporated, with a capital stock of $250,000. The incorporators are: Leander D. Condee and Edward J. Kloss.

ROCKFORD, ILL.—The Rockford, Oregon & Southern Railway Company has been chartered, with a capital stock of $10,000, by Frederick C. Jones and Arthur F. Herbert, of Oregon.

BROOKVILLE, IND.—The Electric Light & Ice Manufacturing Company has been incorporated. The capital stock is $75,000 and the directors are J. D. Hall, J. H. Brockman, R. H. Cook and Charles Andrews.

DALE, IND.—The Farmers' Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $10,000 and the directors are: C. W. Randolph, John Wibbeler, John Meier, Wesley Painter and John Ellis.

SAN JACINTO, IND.—The San Jacinto Telephone Company has incorporated and is in the market for material and equipment for the construction of a new telephone plant. A. E. Grimes is president.

UNION MILLS, IND.—The Northern Indiana Telephone Company has been incorporated, with a capital of $10,000. The directors are: Ray Dye, J. F. Underwood, John R. Bailey and Thomas Edminson.

RED OAK, IA.—Articles of incorporation have been filed for the Montgomery County Telephone Company with a capital stock of $41,800. H. E. Deemer is president.

SOUTH WEST HARBOR, ME.—The Island Telephone Company has been incorporated with a capital stock of $10,000 by Guy H. Parker, president, and others.

ST. CLOUD, MINN.—The Zion Telephone Company has filed articles of incorporation with a capital stock of $6,000. Fred C. Nehring is president.

KANSAS CITY, MO.—The Union Gas & Traction Company has been incorporated with a capital stock of $5,000 by C. H. Pattison, B. J. Mattocks and others.

AURORA, NEB.—Articles of incorporation have been filed for the Farmers Telephone Company with a capital stock of $10,000 by John George and others.

DENTON, NEB.—The Kramer-Denton Telephone Company has been incorporated with a capital stock of $25,000 by Benjamin G. Miller and others.

WISNER, NEB.—The Bancroft Telephone Company has been incorporated, with a capital stock of $7,000.

ASBURY, N. J.—The Federal Light, Heat & Power Company has been incorporated, with capital stock of $125,000, by Daniel Moor, Douglass R. Clarkson and John B. Sabine.

JERSEY CITY, N. J.—Articles of incorporation have been filed for the Williamsport Light Company. The capital stock of the company is $500,000, and the incorporators are Alfred Ely, Jacob Delmer and William H. Carey. The company will operate electric and gas plants.

PALISADE PARK, N. J.—Articles of incorporation have been filed with the Secretary of State for the Radio Telephone Company by Lee De Forest, Samuel E. Darby, Henry Froukel, Walter J. Scott and Fred W. Southemer. The company is capitalized at $2,000,000.

SOUTH ORANGE, N. J.—Articles of incorporation have been filed for the South Orange Illuminating Company. The company is capitalized at $100,000, and the incorporators are: Thomas A. Gillespie, Allerton D. Hitch, Ira A. Kipp, Jr., Arthur B. Leech and Andrew S. Marsh.

SILVER CITY, N. M.—The Silver City, El Paso & Southwestern Telephone Company has been incorporated. The organizers of the company are: J. H. Morgan, of El Paso; C. B. Murray, of Central; William Bosworth, of Deming; Clyde Smith, of Silver City; W. E. Baker, of Las Cruces.

DEPEW, N. Y.—The Buffalo, Genesee & Rochester Railway Company has been incorporated, with a capital stock of $7,500,000. The directors are: Henry H. Kingston, Jr., Samuel Welch, of Philadelphia, Pa.; John Baker and Herbert P. Bissell, of Buffalo, N. Y.

CHARLOTTE, N. C.—The Bradshaw Electric Company has been incorporated, with a capital stock of $50,000, by C. R. Bradshaw, Oliver Holmes and others.

NORTON, N. D.—The Norton Farmers' Telephone Company has filed articles of incorporation, with a capital stock of $10,000. The incorporators are: Harry Fletcher, Carl L. Johnson, of Vesta, and Anders J. Bylin, of Norton.

ELYRIA, OHIO.—The Lorain County Home Telephone Company has filed articles of incorporation. The company is capitalized at $750,000 and is said to be a merger of the Elyria, Oberlin, Wellington, Ridgville, Amherst and Elyria Southern Telephone & Tool companies. It is also stated that the Black River Telephone Company has been absorbed by the company.

MIDDLETOWN, OHIO.—The Middletown Telephone Company has been granted a charter by the Secretary of State. The company is capitalized at $10,000 and the incorporators are: Walter S. Harlan, David B. Bundy, Jr., L. T. Palmer, Allen Andrews and Lulu C. Harlan.

PORTLAND, ORE.—Articles of incorporation have been filed for the Municipal Railway & Improvement Company by J. A. Ward, G. A. Hoffman and D. A. Spanton. The company is capitalized at $60,000.

BIG RUN, PA.—The Big Run Light, Heat & Power Company has been incorporated, with a capital stock of $5,000, by Austin Blakeslee and others.

HARRISBURG, PA.—The Columbia & Manor Street Railway Company has been granted permission to increase its capital stock from $102,000 to $225,000 for the completion and equipment of its line.

HARRISBURG, PA.—The Ohio River Passenger Railway Company has been permitted to increase its capital stock from $70,000 to $1,000,000. The indebtedness of $1,000,000 will be secured by the issuance of 1000 $1,000 first mortgage bonds. Van Horn Ely is president.

NORRISTOWN, PA.—The Philadelphia, Valley Forge & Suburban Railway has been granted a charter to build an electric railway. The company is capitalized at $60,000. L. Knowles Perot is president of the company.

WAYNESBURG, PA.—A charter has been granted to the Greene County Telephone & Telegraph Company. The capital stock of the company is $50,000, and the directors are: W. H. Baily, Challen W. Waychoff, Waynesburg; T. B. Lee, Pittsburg; J. N. Scott, W. S. Scott, Jefferson township, Greene County; Thomas Hughes, Rices Landing; S. S. Bayard, Carmichaels.

ARLINGTON, TEX.—The Arlington Light, Power, Ice & Water Company has been incorporated, with a capital stock of $40,000, by W. M. Dugan and others.

GALVESTON, TEX.—The Galveston-Houston Electric Light Company has been incorporated, with a capital stock of $6,000,000, by William K. Neal, Charles E. Gurney and others. This company is a construction company formed for the purpose of taking over the plants of Galveston-Houston Interurban Company, which was recently chartered at Austin, Tex. David Daly is manager.

Legal.

DUTY OF TELEPHONE COMPANY TO FURNISH WORKMAN OF ANOTHER COMPANY WITH SAFE PLACE IN WHICH TO WORK.—In an action against a telephone company to recover damages for alleged negligence resulting in the death of an employee of another company, the defendant company cannot be held liable in the absence of proof that it was aware that the deceased workman was about to go upon its lines or that there was a contract or understanding with the company which employed the deceased to the effect that its workmen might go upon the poles and wires of the defendant company. Under such circumstances the defendant company was under no duty to provide the deceased workman with a safe place in which to work. Louisville Home Telephone Company vs. Beeler's Administrator, Court of Appeals of Kentucky, 101 S. W. Rep. 397.

RIGHT TO SELL ELECTRICITY.—A decision has been handed down by Justice Fitzgerald, of the New York Supreme Court, against the Interborough-Rapid Transit Company for using subway ducts to supply electrical energy to the New York City Railway Company. This is now enjoined. He says: "The use of these ducts for the sale and transmission of electric current for motor power to third parties, whether the owners or operators of connecting or intersecting railroads or not, is a use of the public property, contrary to the plain purpose of the Rapid Transit act, not reasonably contemplated by the parties to the instrument of contract and lease executed thereunder, in no sense a railway use within the rules stated, and, in so far as the company seeks to charge the cost of the generation and transmission of such electric current against the sum upon which its indebtedness to the municipality shall be computed, manifestly unjust to the city."

PURCHASER OF ELECTRICAL SUPPLIES, SOLD UNDER WARRANTY, MAY MAINTAIN ACTION FOR BREACH OF WARRANTY WITHOUT RETURNING THE PROPERTY.—An electrical supply company entered into a contract with a city under which it agreed to furnish all the material and machinery and perform all the work necessary in the installation of an electric light plant of 900 lights capacity. The company expressly warranted that the appliances and material would be the latest and most approved at that time, to the end that it would be an efficient and first-class plant in every particular and in all its parts when completed. An action was brought by the city to recover damages for a breach of warranty, it being alleged that the plant was not a first-class plant of 900 lights capacity, in this, that the engine, boiler and dynamo used in the plant were not of sufficient size and capacity to operate the plant. It was held that the plaintiff was entitled to recover against the defendant company without returning or offering to return the defective parts, the amount of damages being the difference between the plant installed and the plant which the plaintiff contracted for and the defendant agreed to furnish. Duncan-Hobson Electric Company vs. City of Coleman, Court of Civil Appeals of Texas, 100 S. W. Rep. 1004.

TRAIN LIGHTING PATENTS.—Suit has been brought in New Jersey in the Court of Chancery before Vice-Chancellor Emery by the Consolidated Railway & Electric Equipment Company against the United States Lighting & Heating Company, to decide the ownership of some of the patents issued to Morris Moskowitz for generating electricity from car axles for lighting passenger coaches and to compel the defendant company to transfer the patents to the complainant. Mr. Moskowitz was the inventor of a lighting system, and in 1894 he assigned his patents to the National Electric Car Lighting Company, which subsequently assigned its interest, together with a contract with Moskowitz, to the complainant. Moskowitz continued to perform his duties for the company until 1902, when he organized the defendant company and became associated with it. Since then, it is asserted, the defendant has had the benefits of his services and knowledge. It is of the patents issued to Moskowitz since 1902 that the court is asked to settle the ownership of. Counsel for the defendant holds that the contract held by assignment is not enforceable, as its terms have been violated. It is also contended that the patents issued to Moskowitz since 1902 relate to a different system of lighting cars from that patented by him previously and assigned under his contract.

EXERCISE OF THE RIGHT OF EMINENT DOMAIN BY STREET RAILROAD CORPORATION.—Under the statutes of the state of Indiana street railway companies are authorized to take property by emi-

nent domain and it is provided that the company exercising the right shall deposit with the clerk of the Circuit Court, or other court of record, a description of the properties and interests to be appropriated, and that such lands, rights or interests shall belong to the company to use for the purpose specified by making or tendering payment. The statutes further provide that if the parties cannot agree upon the compensation, notice shall be served by delivering a copy of the instrument of appropriation, whereupon three appraisers shall be appointed upon the application of either party, who shall return their assessment of damages. In condemnation proceedings brought by the Ft. Wayne & S. W. Traction Company against the Ft. Wayne & W. Railway Company, it was held that the filing of the instrument of appropriation with the designated officer constituted a seizure and appropriation of the land therein described and was the final act of taking, upon which title passed and all damages resulting from the taking thereupon vested in the then owner of the land as a personal claim. Ft. Wayne & S. W. Traction Company vs. Ft. Wayne & W. Railway Company, Supreme Court of Indiana, 80 N. E. Rep. 837.

INFRINGEMENT OF PATENT BY THE FEDERAL GOVERNMENT.—The plaintiff brought an action upon a verbal agreement said to have been made in 1879, whereby he agreed "to employ his best efforts and best endeavors in a lawful manner to have the Congress of the United States pass an act making an appropriation for the defendant for damages which it sustained by reason of the United States infringing certain patents which were owned or controlled by the defendant, and that the defendant agreed in consideration of the plaintiff's aforesaid agreement, to pay and allow to plaintiff 20 per cent of any and all sums obtained from the government of the United States pursuant to any act of Congress which the plaintiff would lawfully procure to be passed, or which would be passed through his efforts." The plaintiff visited Washington fairly regularly until 1883 for the purpose of promoting the passage of the bill, but did nothing between 1883 and 1897, except that he went to the capital two or three times "on his own hook," as he expressed it. The appropriation was eventually made through the efforts of a Mr. Creecy. The plaintiff had nothing to do with Creecy except that he advised his employment by the defendant. It was held that the plaintiff was not entitled to the commission claimed. His right to compensation was dependent upon his success in securing the appropriation and he never succeeded. Swift vs. United States Regulation Firearms Company, New York Supreme Court, Appellate Division, 103 N. Y. Supp. 736.

MUNICIPAL PLANT PURCHASE.—At Frankfort, Ky., in affirming judgment of the Hopkins Circuit Court in a case of R. W. Overall against the city of Madisonville, the Court of Appeals recently declared that, where a city is given the power, either express or implied, as an incident to its police power, to light its streets, and the precise method is not provided, it may buy or build a lighting plant, and it may do so without submitting the matter to a vote of the citizens, provided it shall not become indebted beyond the revenues and incomes of the year. The court says that in the matter of buying or installing such plant, the city is left wholly to the judgment of its Council as to what kind, the cost, when and where it shall buy, and how much at a time. The decision of the court is of much importance. It was announced by Chief Justice O'Rear, the full bench sitting and concurring. The decision says: "Where a city is given the power, either expressly or by necessary implication as an incident to its police power, to light its streets, and where the precise method is not expressly provided, it may either hire another to furnish the lights, or may furnish its own light. Whether a mere municipal corporation, an arm as it were of the state government, set up for government purposes only, ought to be given the power to engage in a purely commercial business, is a question of politics as well perhaps as of constitutional power. It involves the requiring of every citizen who is a taxpayer to contribute to the enterprise, to become a member of it whether he wills or not. If the municipality may build its own lighting plant for that purpose, and it may, it ought to be permitted to sell the surplus of its product as it would sell horses bought for its fire department when they were no longer needed in the public service, or to sell anything else it rightfully had, but had no further use for. So it is now held that it may sell such surplus property or products. We think the city had the power to install a light plant to furnish public lighting, and, incidentally, as is proposed, light to its inhabitants."

RIGHT TO COMPEL REMOVAL OF TELEPHONE POLES BECAUSE CROSS-ARMS AND WIRES PROJECT OVER PROPERTY ABUTTING ON COMPANY'S RIGHT OF WAY.—In an action against the Cumberland Telephone & Telegraph Company it was alleged that the company, wrongfully and without the consent of the plaintiff, trespassed upon his land by erecting its telephone poles so close to his premises that the cross-arms and wires extended over and among the tops of trees growing upon his land and over a barn on his land, so close to the roof thereof as to render it liable to be struck by lightning. It was also alleged that a guy wire had been stretched across a corner of the plaintiff's lot and it was asked by way of relief, that the company be compelled to remove the guy wire and to place its poles at such a distance from the plaintiff's land that the cross-arms and wires would not extend over his premises. The defendant company argued that it would work a great hardship upon it to require it to remove its system of poles and wires and that the plaintiff should be left to an action for damages and that the injunction sought should be denied. It was held, however, that the suspension of the cross-arms and wires, and the placing of the guy wire, in the manner complained of, constituted an invasion of the plaintiff's rights and that the only adequate remedy was to require the removal of the poles by the company. Otherwise the plaintiff would be compelled to resort to a long and expensive litigation for the purpose of collecting damages. In the opinion of the court it was said: "However useful and necessary corporations like the appellant may be to the public, they are not authorized to take possession of, or injure in any manner or form, the private property of the individual without his consent, or without obtaining in the mode provided by law the right to take his property. To meet the requirements of cases like this, to afford quick relief, to prevent vexatious and costly litigation, to furnish property owners whose rights have been infringed upon proper protection, the remedy by injunction has been extended beyond the limit it formerly occupied, and especially is this true of trespasses intended to be permanent." Cumberland Telephone & Telegraph Company vs. Barnes, 101 S. W. Rep. 301.

Obituary.

MR. E. B. DUNBAR.—We regret to note the death of Mr. Edward Butler Dunbar, of Bristol, Conn., on May 9. He was the president of the Dunbar Brothers Company, and highly esteemed locally as well as in the mechanical field. Mr. Dunbar was 64 years of age, having been born at Bristol, Nov. 1, 1842.

MR. F. L. CLARK.—The death is announced from Los Angeles, Cal., of Mr. Francis Ludlow Clark, long chief engineer of the Westinghouse Air Brake Company, who died there on May 27 of paralysis and heart failure, aged 65 years. He was stricken about six months ago in Pittsburg, and, in the hope of recovery, went to California. Mr. Clark had for the past forty years been connected with the Westinghouse interests, lately in the capacity of chief engineer of the Air Brake Company. He was born on Long Island, N. Y., being a descendant of Gov. Griswold, of Connecticut. When the war broke out he enlisted in an Ohio regiment, being taken prisoner in his first skirmish. He was later paroled. Immediately after the war he became connected with Mr. George Westinghouse. Mr. Clark left a widow and three children.

Personal.

Will M. Dixon.

MR. WILL M. DIXON, chief of the Department of Electricity of the Jamestown Exposition, was born in Urbana, O., on January 6, 1878. After taking up electrical work in Cleveland, he became associated with the mechanical and electrical department of the Pan-American Exposition, of which the late Henry Rustin was chief. At this Exposition, Mr. Dixon's efforts were confined to the execution of the work on the Electrical Tower which formed such a feature of the Buffalo show. At the close of the Pan-American Exposition, Mr. Dixon associated himself with the electrical department of the Louisiana Purchase Exposition, under Mr. Rustin. After Mr. Rustin's retirement on account of ill health, Mr. Dixon was appointed assistant electrical engineer to Mr. E. B. Ellicott, who succeeded Mr. Rustin. Mr. Ellicott retired after the construction period, and Mr. Dixon was appointed electrical engineer of the Exposition, which position he retained until he was appointed chief of the department of electricity of the Jamestown Exposition, where he is in direct supervision of the design and execution of the work pertaining to this department. Mr. Dixon received this appointment at the suggestion of Mr. Rustin, who was unable on account of ill health to accept the position which was tendered to him. In his present position, Mr. Dixon labored under great difficulties in getting the electrical work finished in time for the opening day, the electrical energy being supplied only the day before the opening. This left very little time for testing out the myriad circuits, and the thoroughness with which the electrical work was done is best attested by the fact that the circuits were ready on the opening day. The credit for this Mr. Dixon graciously assigns to his fellow workers, not desiring any personal credit for his part of the work.

MR. D. W. STEWART, of Xenia, O., has been elected president of the North Georgia Electric Company, as successor to General A. J. Warner.

MR. J. ERSKINE-MURRAY, D. Sc. M. I. E. E., has removed his offices as a consulting engineer and wireless telegraphist from Glasgow to Oswaldestre House, Norfolk Street, Strand, London.

MR. C. E. ROLFE, of Baltimore, Md., has been appointed manager of the Chesapeake & Potomac Telephone Company in the Cumberland territory, succeeding Mr. Hamline Q. French.

MR. WILLIAM K. GLENN, formerly master mechanic of the Tacoma Railway & Power Company, has been appointed superintendent of the Portland Railway, Light & Power Company, of Portland, Ore.

MR. EDWARD W. MOORE, of the Everett-Moore Syndicate, has

been appointed president of the Cleveland, Painesville & Eastern Railway Company, of Cleveland, to succeed Mr. Charles Wason, resigned.

MR. C. E. FLYNN has resigned as vice-president and general manager of the Conneaut & Erie Traction Company, of Erie, Pa., to take effect June 30. Mr. E. B. Walker, superintendent of the road, has been appointed to succeed him.

MR. H. W. MANN has recently resigned his position of electrical engineer of the Pueblo & Suburban Traction & Lighting Company, of Pueblo, Col., to take a like position with the Northern Colorado Power Company, at Lafayette, Col.

MR. ALEX M. COVER, superintendent of the South Fork Light, Heat & Power Company, of South Fork, Pa., has resigned his position to take effect June 1, to accept a similar position with the Dale Light, Heat & Power Company, of Johnstown, Pa.

MR. S. BERGMANN, formerly of New York, but now of the Bergmann Electricty Works, of Berlin, has been making a short visit to this country to see Mr. Edison and other old friends. His German enterprises are in a flourishing condition, and Mr. Bergmann keeps abreast of all new developments.

MR. LEWIS E. ASHBAUGH announces his resignation as associate professor of civil engineering at the Iowa State College, Ames, Ia., and his engagement as engineering assistant to Mr. Robert McF. Doble in the development of water power. He will have his offices at 22 and 23 Giddings Building, Colorado Springs, Col.

COL. WASHINGTON A. ROEBLING, engineer of the Brooklyn Bridge, and still at the head of the engineering department of the John A. Roebling's Sons Company, celebrated his seventieth birthday last week with a family reunion and dinner. He also received a number of visitors and congratulations.

PROF. W. D. MARKS, the consulting electrical engineer, etc., has removed his office to Room 623 Park Row Building, New York City. He has just issued a fourth edition of his book on lighting and power finance, including a variety of new matter and a digest of the New York 80-cent gas case.

HILD-HALSTEAD.—The marriage is announced on May 22 of Miss Georgia Marion Halstead, daughter of Mrs. Ellen Halstead, of Dueskirk, Ohio, to Mr. Frederic W. Hild, assistant general manager and chief engineer of the Havana Electric Railway Company, with headquarters in Havana, Cuba.

MR. L. C. BRADLEY has resigned as superintendent of the Scioto Valley Traction Company, of Columbus, Ohio, to take a position with J. G. White & Company, of New York, N. Y. Mr. Bradley was formerly superintendent of the Seattle & Tacoma Interurban Railway and came to the Scioto Valley Company three years ago.

MR. A. E. POIRIER, who for eleven years has been associated with the New Jersey company of the New York & New Jersey Telephone Company, has tendered his resignation, which takes effect June 1. Mr. Poirier was chief of the repair shop of the New Jersey division of the company, and had charge of the designing and repairing of apparatus. He has not decided what his plans for the future will be.

MR. F. GUTZMAN.—Mr. Frantz Gutzman, who arrived last week on the "Deutschland," is a telegraph engineer in the service of the German Government. He came here for the purpose of studying the organization of American telegraph and telephone companies. He will make a thorough investigation of the subject in all parts of the country. The result of his observations will be contained in a report to his government.

MR. W. G. CHACE has associated himself with Messrs. Cecil B. Smith, late chief engineer of the Hydro-Electric Power Commission of Ontario, and Prof. J. G. G. Kerry, late of McGill University, Montreal, in the formation of an engineering firm prepared to investigate, to advise on, and to take charge of the construction of transportation, power development and distribution problems, and kindred engineering matters. Their offices are in the Confederation Life Building, Toronto, Can.

MR. C. W. KOINER, who for the past two years has been occupying the positions of secretary-treasurer and engineer of the National Light & Improvement Company, of St. Louis, operating the Wichita (Kan.) Gas, Electric Light & Power Company, the Fort Worth (Tex.) Light & Power Company, the Waco (Tex.) Gas Company and the Citizens' Railway Company, Waco, Tex., has resigned, to take effect June 1, in order to accept the position of general superintendent and engineer of the Los Angeles (Cal.) Gas & Electric Company.

MR. BYRON L. WATERMAN, of Pawtucket, R. I., has been elected treasurer of the Woonsocket Electric Machine & Power Company to succeed Mr. E. F. Allen, resigned. Mr. Waterman represents the Frank A. Sayles interests and the statement is made that the appointment may be only temporary. Mr. Waterman is secretary-treasurer of the River Spinning Company, of Woonsocket, in which Mr. Sayles is heavily interested. He will divide his time between the two places and will assume charge of the financial end of the electric light company.

MR. J. I. MATTHIAS.—Col. M. M. Gillett, president and manager of the Licking Light & Power Company, of Newark, Ohio, has resigned as manager of this company and Mr. J. I. Matthias has been elected by the board of directors to succeed him in the active management of the company. Mr. Gillett found it necessary to give up the position as manager, owing to his various other business interests which require his attention. Mr. Gillett is still president of the company and a large stockholder. Mr. J. I. Matthias, who succeeds Mr. Gillett as general manager, has been with the company for the past year as new-business manager, and is well qualified by practical experience and knowledge of the electric lighting business to successfully operate the property. Mr. Matthias went to the Licking Light & Power Company from the Philadelphia Edison Company, of Philadelphia, Pa. He has made a study of all branches of electric lighting, and is thoroughly competent to deal with the responsibilities of his new position.

Trade Publications.

ENGINES AND BOILERS.—The Robb Engineering Company, Amherst, N. S., Canada, has issued a catalogue describing in detail Robb-Armstrong engines. The company has also issued a catalogue dealing with steam boilers of all types.

STATIONARY STORAGE BATTERIES.—The Westinghouse Machine Company, East Pittsburg, Pa., has issued catalogue S giving an excellent description of the Westinghouse storage batteries for stationary use. These batteries are of the lead type formed by the Plante process.

MACHINISTS' TOOLS.—The Brown & Sharp Mfg. Company, Providence, R. I., has issued an artistically illustrated circular dealing with six machinists' tools which have recently been placed on the market, namely, a pocket scriber, a spacing attachment, a pocket center punch, combination caliper and divider, micrometer caliper set and steel rules with holder.

ELECTRICAL MEASURING INSTRUMENTS.—Catalogue No. 14, of the Keystone Electrical Instrument Company, Philadelphia, Pa., deals with indicating instruments for either direct or alternating current circuits in switchboard and portable types. A somewhat unusual feature of the catalogue is found in the fact that all of the illustrations are from line cuts and no half-tones are employed.

VENTILATED AND ENCLOSED RHEOSTATS.—The Ward Leonard Electric Company, Bronxville, N. Y., has issued a pamphlet calling attention to the fact that there is no reason why an enclosed rheostat may not be also a ventilated rheostat. It is stated also that all enclosed rheostats are not of the "sand-box" type, and that all ventilated rheostats do not employ exposed iron wire. It is claimed that the Ward-Leonard Electric Company has been manufacturing "enclosed-ventilated" types of rheostats in addition to the sand-box type for more than ten years.

DIRECT-CURRENT FANS.—A tastily prepared and executed bulletin designated as No. 55, has been issued by the Robbins & Myers Company, Springfield, Ohio. The bulletin is devoted to direct-current fans. It is of letter size and has been designed for the use of dealers in fans who wish to reach certain customers by mail. The front cover is illustrated with a gilded fan which furnishes a breeze to a "Standard" fan banner, while the folder is closed with a golden seal representing the highest award at St. Louis in 1904.

THE WESTERN ELECTRIC COMPANY has issued the 1907 edition of its supply catalogue, which forms a large volume of 700 pages, and lists practically everything of any importance in the electrical line. While the supply catalogues of the Western Electric Company are primarily gotten up to furnish a complete list of all material handled by that company, they also embody such features of general interest to the electrical trade, as to make the publication a desirable adjunct to the catalogue literature used by purchasing agents all over the United States and Canada.

ELECTRIC PROPELLER FANS.—Bulletin No. 146, just issued by the B. F. Sturtevant Company, Boston, Mass., illustrates and describes electric propeller fans. These are built in a full line of sizes from 18 in. to 120 in., and are carried in stock at works and branch warerooms in sizes up to 48 inches, wound for 110 and 220 volts. Both fan and motor are manufactured by the B. F. Sturtevant Company and are designed to give a combination of highest efficiency. The motor is dust proof; the fan may be placed in any location and controlled by switch from a distance. This type of fan, by continually substituting cool and pure air for that which is hot and vitiated, contributes alike to the comfort of those who labor and those assembled for amusement. In the dye house, the laundry, the kitchen, and the boiler room, it maintains an atmosphere free from steam, odors, or overheated air. The more extensively this type of fan is used, the more its convenience and simplicity of operation are appreciated.

Business Notes.

THE OSBORNE ENGINEERING COMPANY, Cleveland, Ohio, has been engaged as consulting engineer to prepare plans for bridge over the Ohio River and to make surveys for about 12 miles of railway between Owensboro, Ky., and Rockport, Ind. A corps of engineers will be placed in the field at once to make surveys for railway and bridge.

COLUMBIA LAMPS.—The Columbia Incandescent Lamp Company, of St. Louis, held its annual conference of salesmen on May 23, 24 and 25 at the St. Louis offices and factory. A full meeting was held, and the men were very enthusiastic over the past business of the company in their respective territories and the outlook for the coming season. The business sessions were agreeably intermingled with entertainments in the evening in the shape of dinners and visits to the theaters and summer gardens.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electro-Therapeutical Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, fourth Friday of each month. Annual meeting, Niagara Falls, N. Y., June 24, 1907.

American Street and Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting, Detroit, Mich., third Wednesday, September, 1907.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St. New York. Next meeting, Atlantic City, N. J., October 14-18, 1907.

Association of Edison Illuminating Companies. Secretary, George R. Stetson, New Bedford, Mass.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Atlantic City, N. J., June 19, 1907.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting, Montreal, September, 1907.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont. Semi-annual meeting, Windsor, Ont.. June 14 and 15, 1907.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col. Next meeting, September, 1907.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Chas. J. Sutter, 1229 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 1537 Old Colony Building, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 7, 1907.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas and Electrical Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting, October, 1907.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, Dr. Arthur H. Elliot, 4 Irving Place, New York. Meetings in New York, second Friday of each month.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

International Independent Telephone Association. Secretary, C. C. Deering, Boone, Iowa. Next meeting, Chicago, June 4, 5 and 6, 1907.

Iowa Electrical Association. Secretary, L. B. Spinney, Iowa State College, Ames, Ia.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday, March, 1908.

Iowa Street and Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kan., Oct. 16, 1907.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Battle Creek, Mich., August 21-23, 1907.

Missouri Independent Telephone Association. Secretary, Houck McHenry, Jefferson City, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, W. C. L. Eglin, Philadelphia, Pa. Next meeting, Washington, D. C., June 4, 5, 6 and 7, 1907.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y. Next meeting New York City, July 17, 18 and 19, 1907.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next annual meeting, Chicago, second Thursday in June, 1907.

National Interstate Telephone Association. Secretary, A. L. Tetu, Nashville, Tenn.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y. Next meeting, Syracuse, N. Y., June, 1907.

Northwestern Electrical Association. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1908.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, O. Next meeting, Toledo, Aug. 20 and 22, 1907.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Portsmouth, Ohio.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, F. W. Ballard, 104 Canal St., Cleveland, O.

Oklahoma Electric Light, Railway & Gas Association. Secretary, Charles W. Ford, Oklahoma City, Okla.

Old Time Telegraphers and Historical Association. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls, N. Y., 1907.

Pacific Coast Electrical Transmission Association. Secretary, Samuel G. Reed, Portland, Ore.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

Public Utilities Association of Indiana. Secretary, J. A. Shunk, Peru, Ind. Regular meetings second Thursday in May and December.

South Dakota Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electrical & Gas Association. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, J. H. Pardee, Canandaigua, N. Y.

Vermont and New Hampshire Independent Telephone Association. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Underwriters' National Electric Association. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED MAY 21, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

853,971. DEVICE FOR COLLECTING MINERS' CHECKS; Frank C. Greene, Cleveland, O. App. filed Sept. 17, 1906. An improved method of handling miners' checks. A pivotally mounted arm with a magnet thereon is mounted adjacent to a track-section of a dump, and adapted to swing in proximity to a passing car.

853,989. VACUUM-TUBE LAMP; Daniel M. Moore, Newark, N. J. App. filed Apr. 21, 1904. An electric gas or vapor lamp containing an electrically treated hydro-benzamid.

853,990. AUTOMATIC ELECTRICAL CUT-OFF; Robert Harvey McDowell, Alliance, Pa. App. filed May 26, 1905. An electrical switch device attached to a faucet or cock, whereby an electrolytic purifier is set in operation whenever the fluid is turned on.

854,013. DANGER-SIGNAL FOR PORTABLE ELECTRIC TOOLS; James I. Ayer, Cambridgeport, Mass. App. filed Jan. 14, 1907. Construction of flat iron having a hollow interior chamber containing a resistance element and an electric lamp which glows whenever the current is turned on, so as to indicate this fact.

854,015. LIMIT SWITCH; George Baehr, McKeesport, Pa. App. filed Nov. 3, 1906. A device for automatically limiting motion or travel of elevators, cranes, etc., driven by an electric motor as means for including a limit switch in the motor circuit in one direction of motion and for by-passing the switch when the controller is reversed.

854,018. PROCESS OF REDUCING METALLIC OXIDS; Frederick M. Becket, Niagara Falls, N. Y. App. filed Sept. 23, 1905. The process of reducing refractory metallic oxids which consists in smelting a charge containing a metallic oxid reducible by silicon and a basic flux, the silicon being present in substantially the proportion required to combine with the oxygen of said oxid.

854,020. BRANCH CONDUIT BOX FOR ELECTRIC WIRES; Leon W. Bossert, Utica, N. Y. App. filed Feb. 19, 1906. A branch conduit box for insulating electric wires is divided into chambers for division of the electric wires of a conduit, the divided portions of the box communicating with the conduits of the electric cables in both directions, whereby the wires are spread and branched.

854,025. TELEPHONE TRANSMITTER; Ralph C. Browne, Salem, Mass. App. filed Apr. 25, 1906. Covers detail features of transmitter having granular carbon.

854,028. ELECTRIC WOOL WASHING AND CLEANSING APPARATUS; George D. Burton, Boston, Mass. App. filed Aug. 11, 1905. A plurality of electrodes are mounted in a tank, with an inclined bottom, and having a screen supported a spaced distance above such inclined bottom.

854,039. COMMUTATOR SWITCH; Edward B. Jacobson, Pittsfield, Mass. App. filed Sept. 12, 1906. A coil box switch for automobiles having means by which the circuit of the primary coil is only closed when the commutator is moved into an "advance" position.

854,045. OUTLET BOX; Louis T. La Paugh, Utica, N. Y. App. filed Feb. 7, 1906. An outlet box entirely composed of sheet metal and having bent over ears or lugs upon the cover which enter corresponding openings in the sides of the box.

854,046. OUTLET BOX; Louis T. La Paugh, Utica, N. Y. App. filed Feb. 7, 1906. Relates to modifications of the above.

854,050. ELECTRICAL DRIVING MECHANISM; Gustave C. Marx, Elizabeth, N. J. App. filed Jan. 11, 1906. Controlling device for sewing machines and similar light machinery in which a single movement on the part of the operator causes the starting of the motor, and the coupling of the same to the machine to be driven.

854,066. CLOCK MECHANISM FOR SIGNALS; Frank O. Warner, Baltimore, Md. App. filed Feb. 25, 1907. Has an indicator arranged to be actuated by the closing of an electric circuit and adapted to indicate the exact time of the happening of an event, such as the passage of a train past a given point.

854,094. ELECTRICAL CONDUCTOR AND ARMOR THEREFOR; Charles J. Klein, New York, N. Y. App. filed Sept. 22, 1906. A conductor is inclosed in an armor or casing composed of metallic cones which nest or telescope together.

854,104. VACUUM-TUBE LAMP; Daniel M. Moore, Newark, N. J. App. filed May 25, 1904. A vacuum tube lamp containing graphitic acid as end for the purpose indicated.

854,107. MAGNETIC CLUTCH; Alfred Pick, Yonkers, N. Y. App. filed Mar. 6, 1905. Relates to clutches which are operated electromagnetically. Has a magnet member with friction surface and armatures on either side thereof with oil channels leading to the friction surface, and means for supplying the channels with oil.

854,121. SYSTEM OF ELECTRICAL DISTRIBUTION; Simon B. Storer, Syracuse, N. Y. App. filed Aug. 10, 1905. An electric current regulator comprising resistances having different temperature coefficients in which an electrical balance is established under a predetermined voltage, an electrically operated device brought into action by fluctuations above or below such predetermined voltage, and means actuated by said device to restore such balance.

854,122. SYSTEM OF ELECTRICAL DISTRIBUTION; Simon B. Storer, Syracuse, N. Y. App. filed Aug. 10, 1905. A device for operating electric regulators, including therein resistances having different temperature co-efficients, and motor windings connected in series with said resistances.

854,123. VOLTAGE REGULATOR; Simon B. Storer, Syracuse, N. Y. App. filed Oct. 23, 1906. A system of electrical distribution, including therein two transformers, and automatic means for throwing the whole or part of the transformed voltage of one transformer into the other transformer.

854,153. ELECTROMAGNETIC MEANS FOR TRANSPORTING NON-MAGNETIC MATERIALS; Ethan I. Dodds, Pullman, Ill. App. filed Apr. 27, 1906. The method of supporting a body of non-magnetic material, which consists in resting said body upon an armature and sustaining the latter by the pull exerted thereon by an electromagnet.

854,164. AUTOMATIC SWITCH FOR TELEPHONE INSTALLATIONS; Paul Hildebrand, Münich, Germany. App. filed Aug. 24, 1905. Has dials at the central exchange with arms swinging over contacts thereon.

854,177. ELECTRIC GAS LIGHTER; Edmund H. Pryce, Yonkers, N. Y. App. filed July 11, 1906. The gas jet is surrounded by a casing in which is contained a small magnet acting on a pivoted armature. This armature carries an extension having one of the two gas lighting contacts thereon.

854,195. JUNCTION, OR OUTLET BOX; Leon W. Bossert, Utica, N. Y. App. filed Feb. 10, 1906. Construction of outlet box having one or more blanks or plugs partially severed from the wall thereof and projecting beyond the side wall of the box, ridges struck up from the box and extending through the marginal apertures of said blanks and frictionally engaging the same.

854,200. PROCESS OF MAKING STORAGE BATTERY ELECTRODES; Thomas A. Edison, Llewellyn Park, N. J. App. filed Mar. 30, 1905. The process of making storage battery electrodes, which consists in introducing within a perforated electrode pocket a loosely packed mass of flakes, foils or scales containing metallic cobalt, and in then subjecting the same to a welding temperature to secure integrality thereof.

854,203. TELEPHONE EXCHANGE APPARATUS; Claude D. Enochs, La Crosse, Wis. App. filed Apr. 24, 1905. Telephone exchange apparatus comprising a subscriber's line circuit, a line jack connected with said circuit, a cord plug circuit co-operating with said jack, and means adapted to be included in said circuits when connected to automatically steady the resistance thereof.

854,204. TELEPHONE EXCHANGE APPARATUS; Claude D. Enochs, La Crosse, Wis. App. filed Apr. 24, 1905. The combination with the conductors of a telephone line, a source of current and a signaling instrument in circuit with said line, and a ballast in circuit with said signaling instrument to regulate its voltage.

854,205. CIRCUIT CLOSING DEVICE; Frederic W. Erickson, New York, N. Y. App. filed Jan. 29, 1907. A form of push button adapted to complete an efficient electric circuit. Has a plunger which enters the space between two spring blade contacts.

854,217. ELECTRIC CONDUCTOR; Oliver T. Hungerford, Belleville, N. J. App. filed Feb. 15, 1901. An insulated electric conductor comprising a wire incased by a sheath of felt mounted directly upon the surface of the wire, having irregular interstices between the fibres of the felt and its fibre saturated with an insulating compound.

854,218. INSULATED ELECTRIC CONDUCTOR; Oliver T. Hungerford, Belleville, N. J. App. filed Jan. 11, 1904. Relates to modifications of the above.

854,257. ELECTRIC HEATER FOR CURLING IRONS; Frederick T. Tobler, San Francisco, Cal. App. filed Oct. 4, 1906. A receptacle for an incandescent lamp is made with an elongated cylindrical chamber containing a resistance coil and which is adapted to receive an ordinary curling iron to heat the same.

854,272. HEAT COIL; Frank B. Cook, Chicago, Ill. App. filed Nov. 7, 1903. A form of thermal-cartridge, has a plunger which can be drawn out in case the heat coil is unduly warmed. This cartridge is held between spring blades in the usual way.

854,276. TEMPERATURE REGULATOR; Frederick Darlington, Pittsburg, Pa. App. filed Sept. 5, 1905. A temperature regulator for heat producing devices such as a transformer. A liquid surrounds the transformer which volatilizes at a temperature at which the transformer is to be maintained. Means are provided for condensing the vaporizing medium into its original stage, whereby a uniform temperature is maintained.

854,277. MEANS FOR COOLING TRANSFORMERS; Frederick Darlington, Pittsburg, Pa. App. filed June 25, 1906. Relates to modifications of the above.

854,278. RADIATOR; Frederick Darlington, Pittsburg, Pa. App. filed June 25, 1906. Relates to additional modifications of the above.

854,279. TELEPHONE EXCHANGE SYSTEM; William W. Dean, Elyria, O. App. filed May 19, 1905. In a telephone exchange system subscriber's lines having switching terminals, operators' connective circuits having co-operating switching terminals, and means controlled by the subscribers through said circuits for disconnecting the same for operative purposes from the subscribers' lines, without disconnecting or disassociating the said switching terminals.

854,296. ELECTROMOTOR OF THE INDUCTION TYPE; Frank M. Lewis, Brighton, England. App. filed Nov. 21, 1904. End connections for armature and field windings.

854,300. VACUUM-TUBE ELECTRIC APPARATUS; Daniel McF. Moore, Newark, N. J. App. filed Feb. 7, 1906. The combination of a vacuum tube, a valve chamber closed by a spring diaphragm, a valve acted upon by said diaphragm in a direction to keep the valve closed and means responsive to changes in the gaseous conditions within the tube for lifting the valve.

854,309. SUPPORTING MEANS FOR ELECTRIC APPARATUS; Emerson G. Reed, Wilkinsburg, Pa. App. filed Nov. 3, 1906. Provides a simple and durable means for rigidly supporting the cores and windings of alternating current transformers in suitable tanks, and which may be adjusted to the various sizes of transformer.

854,311. TRANSFORMER COIL SUPPORT; Charles E. Skinner, Wilkinsburg, Pa. App. filed Sept. 13, 1905. Has an extensive frame for maintaining the proper relative positions of the coils of the transformer under mechanical and electrical strains.

854,312. MEANS FOR COOLING TRANSFORMERS; Charles E. Skinner, Wilkinsburg, Pa., and Samuel M. Kintner, Pittsburg, Pa. App. filed Oct. 3, 1905. A complete refrigerating outfit, including driers, coolers, filters and pumps, through which the cooling fluid circulates.

854,315. INSULATOR; Henry D. Stauffer, Oregon, Ill. App. filed July 24, 1905. An insulator comprising two metallic sections, each supporting a section of insulating material and each section of insulating material supporting a metallic plate between which the line wire is received, and means for clamping the opposite metallic sections together.

854,316. ELECTRICAL APPARATUS; Wilbur H. Thompson, Wilkinsburg, Pa. App. filed Nov. 23, 1906. A transformer comprising a primary coil, a plurality of independent core members and secondary windings that are severally influenced by said core members.

854,318. ELECTRIC STERILIZER; Julius B. Wantz, Chicago, Ill. App. filed Mar. 9, 1907. Details of construction of a tank having a plurality of chambers which contain resistance coils imbedded in cylindrical rods of insulating material. This facilitates the removal of the resistance elements.

854,321. DYNAMO ELECTRIC MACHINE; Joseph A. Williams, Cleveland, O. App. filed Feb. 28, 1906. An electric generator having a rotatable member of magnetic material mounted to rotate about an axis which is substantially coincident with the axis of the winding.

854,326. BATTERY PLATE AND PROCESS OF MAKING SAME; Joseph Bijur, New York, N. Y. App. filed Aug. 14, 1906. Means for welding together active portions or material of a storage battery with the ordinary lead grill or frame. Consists in superheating a lead globule and depositing it without exposure to the air.

854,327. INDICATING MECHANISM FOR ELECTRIC FUSES OR CUT OUTS; Leonard B. Buchanan, Woburn, Mass. App. filed Sept. 14, 1906. An inclosed electric fuse having an auxiliary fuse wire externally to the casing thereof and removably connected to the fuse terminals. Constitutes an indicating device for indicating the condition of the fused wire.

854,328. RAIL BOND PROTECTOR; Leonard B. Buchanan, Woburn, Mass. App. filed Mar. 18, 1907. A guard or plate bond adapted to protect the rail bond from removal by unscrupulous persons.

854,337. TRUNK-LINE TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed June 10, 1901. Complete diagram of circuits.

854,344. ELECTRICAL SIGNALING APPARATUS FOR ENGINES; George J. Exterkamp, Covington, Ky. App. filed Feb. 25, 1907. Relates to details of construction of a railway having a rail between the usual track rails, and specially constructed wheel axles whereby the rails are not short-circuited by a passing train.

854,362. GENERATION AND DISTRIBUTION OF ENERGY; John F. Kelly, Pittsfield, Mass. App. filed Apr. 15, 1903. The combination of an alternating current generator, means for exciting its field magnets by alternating currents derived from the armature circuits, and a freqency setter for determining the periodicity of said generator.

854,363. MAGNET BOX AND ARMATURE OR MAGNET CONTAINED THEREIN; Charles D. Lanning, Boston, Mass. App. filed Jan. 26, 1906. Relates to magnet boxes; designed to protect magnets where the same are exposed to injury; detail features of construction.

854,369. RECEPTACLE AND PLUG FOR ELECTRICAL CONNECTIONS; Walter S. Mayer, Philadelphia, Pa. App. filed Dec. 12, 1906. Construction of outlet box or cut-out adapted to be inserted in the floor or walls of a building, and to lie flush with the surface thereof.

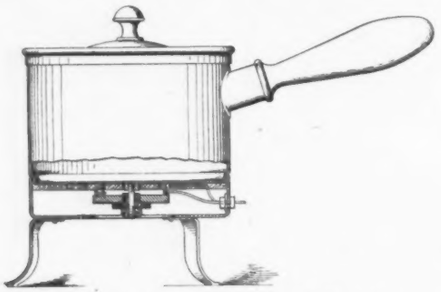
854,396. SAFETY ATTACHMENT FOR ELECTRICALLY HEATED VESSELS; James I. Ayer, Cambridgeport, Mass. App. filed Jan. 14, 1907. A receptacle is made with a chamber having insulated material therein, in which a resistance element is imbedded in a zig-zag path.

854,401. TELEGRAPH TRANSMITTER; John Burry, Ridgefield Park, N. J. App. filed July 21, 1904. Operates for transmitting impulses of a distinctive character over a plurality of conducting paths for the purpose of operating or controlling by their con-joint actions the operation of appropriate receiving mechanism. Has a tank containing heated compressed air and means for discharging the same.

854,413. DEVICE FOR REMOVING STATIC ELECTRICITY FROM STOCK; William Fullard, Plainfield, N. J., and Charles M. Donham, Portland, Me. App. filed June 5, 1906. Discharges hot air against the paper stock in its movement toward and from the press.

854,421. MAGNETO-ARMATURE; Theodore Hubert, New York, N. Y. App. filed Oct. 13, 1906. An armature provided with a winding and having insulation over the winding, and flanges integral with the insulation extending between the sides of the winding and the sides of the armature.

854,425. DYNAMO ELECTRIC MACHINE WITH COMMUTATING POLES; Henry R. King, Hinsdale, Ill. App. filed Nov. 2, 1906. The



854,396.—Safety Attachment for Electrically Heated Vessels.

combination with a direct-current dynamo-electric machine having compensating field windings acting upon the armature coils undergoing commutation, of means for energizing said compensating windings, and an automatic controlling apparatus governing said energizing means, said apparatus being responsive to changes in the current through the armature circuit of said machine.

854,431. PRESS OR SAD IRON; James B. Replogle, Chicago, Ill. App. filed Sept. 6, 1906. A flat iron is made with a heating coil, which magnetizes it so that it is drawn downward toward an iron board so as to relieve the operator from the necessity of applying pressure.

854,436. ELECTRICAL SWITCH; William M. Scott, Philadelphia, Pa. App. filed May 26, 1904. Relates to switches for controlling circuits of large amperage. Has a plurality of members engaging the switch, a toggle for operating each member, and means for restraining said toggles.

854,438. MAGNETO ARMATURE; Charles F. Splitdorf, New York, N. Y. App. filed Nov. 1, 1906. An automobile magneto having heads on the armature with inwardly expanded portions projecting within the winding.

854,439. PORTABLE COMBINATION TELEPHONE SET; Alfred Stromberg, Chicago, Ill. App. filed Nov. 23, 1903. Construction of Hand Microphone having a receiver adjustable on a ball and socket connection.

854,455. LOCK FOR ELECTRIC SWITCHES; Frank W. Brandow, Pittsfield, Mass. App. filed Dec. 12, 1906. A lock is included on the coil box switch of an automobile.

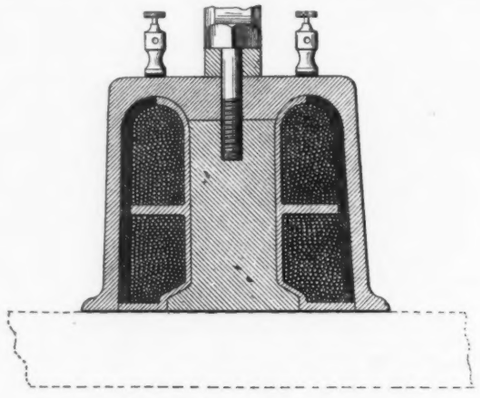
854,472. SANITARY ATTACHMENT FOR TELEPHONE TRANSMITTERS; Josiah W. Dolson, New York, N. Y. App. filed July 3, 1906. A sanitary attachment for transmitters, comprising a frame for attachment to the mouth piece of the transmitter, the said frame having an opening for registering with the opening in the mouth piece, arms extending from the upper end of the frame, at the sides thereof, means for supporting a roll of webbing on the said arms, and guides on the said frame above and below the said opening for guiding the webbing across the said mouth piece, each guide consisting of parallel transverse slots produced in the frame and forming between them a transversely extending bar.

854,493. CLUSTER SOCKET; Gustav A. Harter, Chicago, Ill. App. filed Nov. 22, 1906. A multiple cluster socket having a body of plastic material molded to suitable form, a suitable lamp socket and attachment devices inseparably embedded in the body.

854,508. PROCESS FOR PRODUCING A BLEACHING, STERILIZING OR CONDITIONING AGENT; Sidney Leetham, York, England. App. filed July 16, 1904. A process of producing a bleaching agent, which consists in first ozonizing air and then subjecting it to the action of sparking electrical discharges at a velocity sufficiently high to prevent the complete decomposition of the ozone.

854,541. WIRE WINDING MACHINE; George W. Stancliff, Houston, Tex. App. filed Dec. 155, 1906. Machine for winding coils. Has a rotating spindle and a carriage propelled back and forth thereon by a lead screw.

854,543. PARTY-LINE TELEPHONE SYSTEM; Guy E. Terhune, William M. Eidson and William B. Huston, Willow Hill, Ill. App.



854,431.—Press or Sad Iron.

filed Nov. 11, 1905. In a party-line telephone system, the combination of a line, a generator for energizing the same so as to signal a distant station, electrically operated mechanism for indicating that the line is busy, and means controllable by said electrically operated mechanism for short-circuiting said generator when said line is busy.

854,552. TELEPHONE SWITCH; James S. Alsobrook, Wood Station, Ga. App. filed June 30, 1906. The combination with line conductors of a multiple station line, telephone and call bell, a line switch forming the terminal of the conductors, a telephone switch, and an auxiliary switch in connection with said telephone switch whereby the line may be restored through the auxiliary switch when the line switch is left open.

854,554. ELECTRIC LIGHT FIXTURE; John F. Barrett, Chicago, Ill. App. filed Mar. 16, 1906. A cylindrical casing, contains a spring relay from which depends a flexible cord connection of an incandescent lamp. Has a locking device analogous to that of a spring shade roller.

854,562. ELECTRIC CONDUCTOR OR CABLE; Sidney G. Brown, London, England. App. filed Oct. 8, 1904. An electric cable having a copper conductor associated with an iron conductor, both of segmental form in transverse section and twisted together in an axial direction.

854,627. LETTER BOX; Norman T. Cheney, Batavia, Ill. App. filed Mar. 10, 1906. A letter box has a lever or device thereon which closes an alarm circuit when mail is deposited in the box.

854,662. ELECTRIC CONDENSER; Ignacy Moscicki, Fribourg, Switzerland. App. filed Feb. 17, 1904. An electric condenser comprising a vessel of insulating material containing an electrolyte, two-coiled tubular dielectrics, the coils of one surrounding the coils of the other, both being immersed in the electrolyte contained in the vessel, each tubular dielectric containing an electrolyte conductor, and conducting terminals inserted within the tubular dielectrics and immersed in the electrolytic conductors contained therein.

854,688. CONTROLLER OPERATING MEANS; Arthur J. Brown, Norwood, O. App. filed Aug. 27, 1906. A form of controller having a quick-break mechanism. The controller drum has a spring or resilient connection with the handle shaft. A detent device is provided by which it follows the movement thereof abruptly.

854,704. DYNAMO ELECTRIC MACHINE; Walter J. Richards, Norwood, O. App. filed Aug. 27, 1906. The process of producing aromatic alcohols by electrically reducing aromatic asters, making use of a lead cathode.

12,654. PROCESS FOR THE PRODUCTION OF AROMATIC ALCOHOLS AND THEIR DERIVATIVES; Charles Mettler, Münich, Germany. App. filed June 29, 1906. A dynamo-electric machine having main and commutating windings, and means for causing the current strength in the commutating windings to vary in greater proportion than the main current.